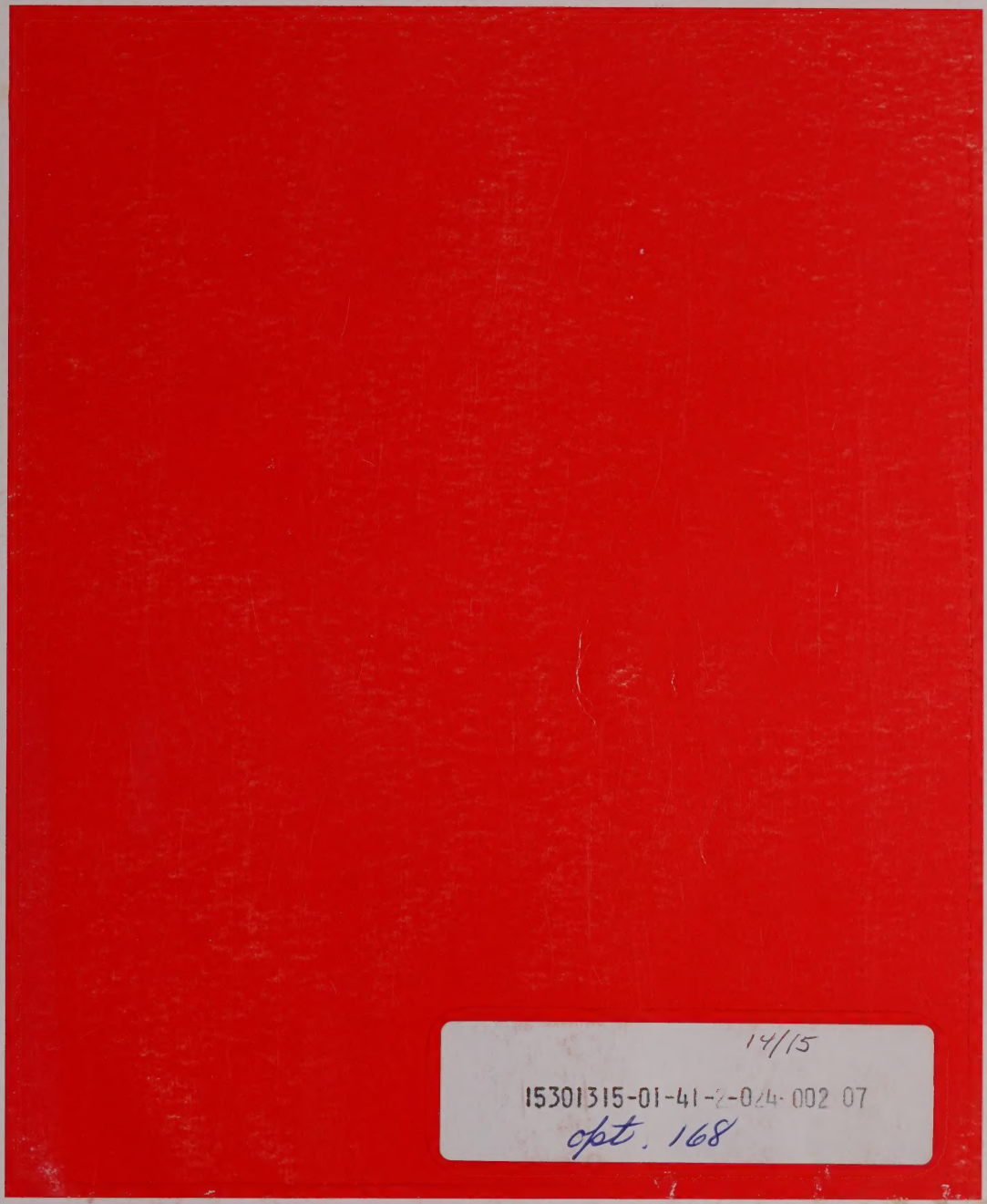

OPERATOR'S MANUAL

Honeywell

IMPORTANT NOTICE

The device described herein has been manufactured and tested for correct operation and conformance to our published specifications and is warranted to perform as advertised.

Should your instrument require recalibration after a period of time, you will find instructions covering this procedure in the appropriate section of this manual.

Recalibration, unless required because of a defective component or workmanship, is considered a normal maintenance function.

Replacement of components and assemblies, where examination indicates the normal recommended maintenance practices, described herein, have not been followed, may not be covered by your warranty. In addition, expendable items such as pens, ink pads, slidewire contactor, relay contacts and other components of a similar nature are not normally covered by warranty unless examination reveals that replacement or repair is necessitated due to faulty workmanship or components.

Should you have any questions relative to your warranty, please contact your nearest Honeywell office or write to the Director of Quality Assurance, Honeywell, Fort Washington, Pennsylvania 19034.

FOR THE RECORD...

. . . be sure to use Honeywell recording accessories
(See back cover for further details.)

CHARTS PENS INKS

*ElectroniK 14*or 15**
Strip Chart Contact Controller

NUMBER 001-5 ISSUE 2

HONEYWELL- Process Control Division, 1100 Virginia Dr., Ft. Washington, Pa. 19034

*Trademark-Honeywell Inc.

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SINGLE-PEN CONTACT CONTROLLER DESCRIPTION

1. PURPOSE AND USE

a. The ElectroniK 15* Strip Chart Contact Controller is a continuous balance instrument which measures and records the magnitude of a process variable and initiates contact control action whenever the process variable departs from the selected value.

b. The instrument continuously compares the feedback voltage from a measuring circuit with an input voltage generated by a primary element and responds to a changing input voltage by rebalancing to record the change in terms of the process variable. Availability of a great variety of features and options makes this instrument flexible enough to satisfy most application requirements.

2. CONTROL ACTION

a. Mercury switch control mechanisms are supplied to provide the specified contact action for operation of solenoid valves, motors, furnace heating elements, or other final control equipment, either directly or through intermediate control units or contactors.

b. The specified mercury switch control mechanism is mounted on the back of the instrument chassis; it provides contact control at a set point selected from the front of the chassis (or from the door when the optional external index setting knob is supplied). The switch configuration, rating, and contact action are described later in this manual.

c. Where greater current carrying capacity is required, either one or two mercury plunger relays can be supplied. These heavy-duty relays are recommended for non-inductive loads up to 30 amperes at 120 volts. They are mounted in the rear of the instrument case and are operated by mercury switch control units.

3. SPECIFICATIONS

a. Supply voltages between 107 and 127 V ac are recommended. An optional stepdown transformer can be supplied for voltages between 214 and 254 V ac.

b. The instrument is designed for operation at the specified frequency (50 or 60 cycles per second).

c. Ambient temperature at instrument location should be between 32°F and 140°F.

d. Span step response time is the time required for the indicator to travel from 0% to 100% of full scale and balance within the limits of specified accuracy, in response to a step change equal to instrument span. The nominal span step response time is actually a maximum rating.

**Honeywell Trademark*

111-0119-153

e. Temperature limitations at instrument and source impendance limitations depend on amplifier design. The specific amplifier supplied is described later in this manual.

Calibrated accuracy and sensitivity ratings are as follows:

TABLE I

Response Time	Resistance Thermometer		Potentiometer			
	Accuracy*	Sensitivity*	Span	Accuracy*	Span	Sensitivity*
24 seconds	±1/5%	.035%	Over 10 MV	±1/5%	Over 12 MV	.035%
			Under 10 MV	±20 microvolts	Under 12 MV	4 microvolts
12 seconds	±1/5%	.035%	Over 10 MV	±1/5%	Over 15 MV	.035%
			Under 10 MV	±20 microvolts	Under 15 MV	5 microvolts
4-1/2 seconds	±1/4%	.035%	Over 12 MV	±1/4%	Over 20 MV	.035%
			Under 12 MV	±30 microvolts	Under 20 MV	7 microvolts

*Percentages shown above are in per cent of instrument span

1. GENERAL

a. The basic single record strip chart controller is shown in figure 1. The three-section, die-cast aluminum chassis houses the display components servo drive system, and the chart drive and reroll system. If optional features (not shown) have been supplied, they are described later in this manual. Rotation of the chassis latch 1/4 turn will release or lock the chassis.

b. The display section of the chassis includes the chart, tear-off strip, recording and indicating carriage, calibrated scale, and the slidewire and housing assembly.

c. Control components are determined by the specific control form; they are described later in this manual.

2. DRIVE SYSTEMS

a. The servo system includes the balancing motor, drive gear, drive cable, and slidewire. Slidewire contactors are part of the carriage assembly. The instrument power switch, drive gear, and chassis terminal block are on the back of the chassis.

b. The chart drive system includes the chart drive motor (back of chassis) drive mechanism, switch, motor capacitor, drum, supply spindles, reroll spindles, and reroll drive chain.

LEGEND

1. Chart plate
2. Reroll spindles (2)
3. Supply spindles (2)
4. Retaining spring
5. Chart drive switch
6. Guide rod
7. Tear-off strip
8. Scale
9. Indicator (process variable)
10. Set point index
11. Slidewire assembly
12. Slidewire housing retaining knob
13. Index setting knob
14. Recording pen
15. Chart drum
16. Chart advance knob
17. Balancing motor
18. Chassis latch knob
19. Reroll knob
20. Chart motor capacitor

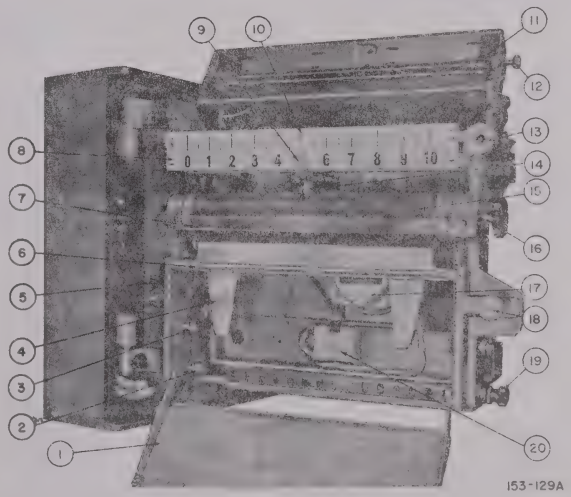


Figure 1. Chassis, front view.

ENCLOSURE DESCRIPTION

CASE

The instrument is housed in a dust and moisture resistant steel case which is suitable for either flush or surface mounting. When specified, a laboratory feet accessory kit is included to make bench mounting more convenient. External dimensions are specified on the drilling dimension drawing included in this manual.

The exterior finish of the case resists normal industrial atmospheres. Convenient knockouts are supplied for the conduit connections and for easy field installation of additional standard features. The case includes mounting facilities for the amplifier, measuring circuit unit, unit for regulating power to the measuring circuit, and terminal blocks for connections to power, primary elements, and auxiliary equipment and optional features.

1. Two-pen instruments contain two amplifiers, two measuring circuit units, and two constant voltage units.

2. In pneumatic controllers, air gages (and bypass panel when specified) are integrally mounted on the bottom of the case.

3. In electric proportioning controllers, the control unit (when ordered) is integrally mounted on the bottom of the case.

Electrical components are described in detail later in this manual.

DOOR

The enclosure is equipped with a phenolic door assembly which can withstand high ambient temperatures.

The entire instrument scale and a portion of the chart are visible with the door closed. Rotation of the door latch 90 degrees will release or secure the door.

NOTE: On one-second recorders, two 25 mfd capacitors are mounted in the lower left corner of the case.

QUICK RANGE CHANGE MEASURING CIRCUIT WITHOUT DAMPING

DESCRIPTION

1. GENERAL

a. Measuring circuit components are mounted on a panel (figure 1). Electrical connections from the primary element, amplifier, constant voltage unit, and slidewire are made to clearly identified terminals.

b. An electrical span adjustment (R_{SA}) is provided. Range changes are simplified because the basic range resistors and the reference junction spool (R_{NI}) are each mounted on independent sub-panels. A screwdriver is the only tool required to change these components. Burnout is supplied if specified.

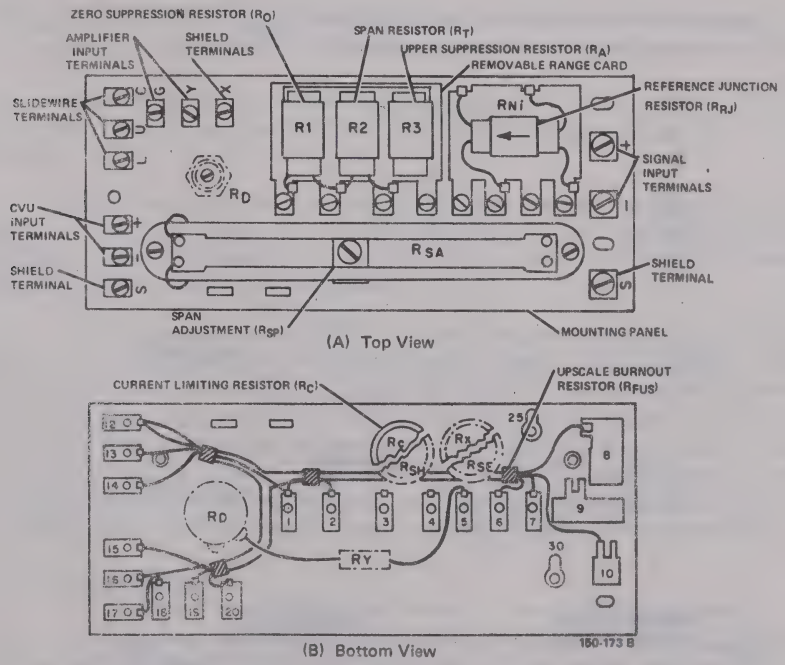


Figure 1. Measuring Circuit Unit

2. CIRCUIT

a. The measuring circuit is shown in the schematic diagram (figure 2).

b. Resistors R_O, R_T, and R_A determine the range of the measuring circuit. The slidewire R_{SW}, shunt resistor R_{SH}, span adjustor R_{SA}, and the span resistor R_T combine to form the span network.

c. The lower branch of the bridge includes reference junction compensating resistor R_{RJ} and current limiting resistor R_C; the upper branch includes zero suppression resistor R_O, upper suppression resistor R_A, and the span network.

d. Burnout, if supplied:

(1) The upscale burnout resistor R_{FUS} is connected between the thermocouple negative input terminal and the negative output of the Constant Voltage Unit (CVU) at the bridge.

(2) For downscale burnout resistor R_{FDS} is used and R_{FUS} is omitted. (See Table in figure 1).

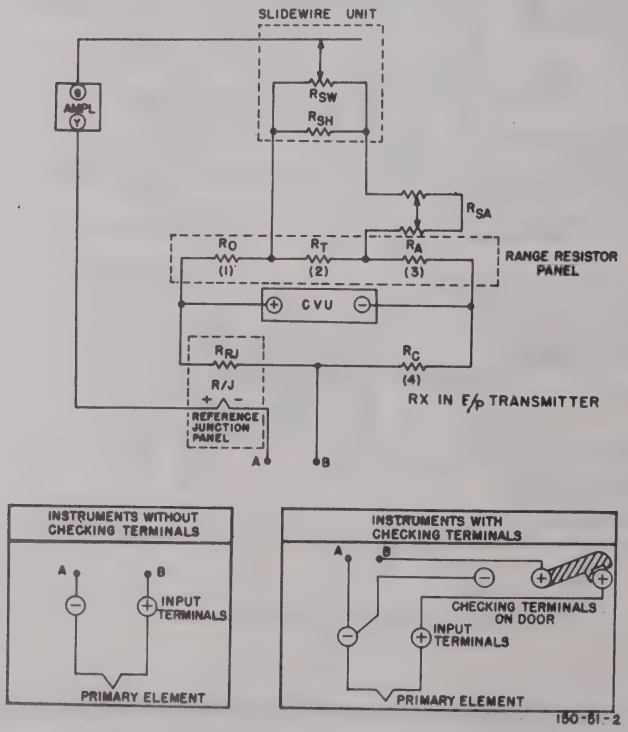


Figure 2. Schematic Diagram of the Measuring Circuit

QUICK RANGE CHANGE
MEASURING CIRCUIT
WITHOUT DAMPING

DESCRIPTION

3. OPERATION

a. The output of the CVU is applied across the measuring circuit and maintains a stable current through the circuit. Individual branch currents are determined by branch resistance ratios.

b. Voltage drop across zero suppression resistor R_O causes the instrument to indicate 0% full scale when primary element voltage is equivalent to 0% full scale.

c. Value of the span resistor R_T is such that equivalent resistance of the span network develops a voltage drop equal to instrument span.

d. Span adjustor R_{SA} permits critical adjustment to compensate for small resistance variations in interconnecting wires, solder junction, etc.

e. Values of upper suppression resistor R_A and current limiting resistor R_C are selected to maintain the required ratio between the circuit branches.

f. The value of reference junction compensation resistor R_{RJ} remains constant on millivolt ranges; on thermocouple ranges it changes with temperature variations, thus compensating for the difference between a varying ambient temperature and a fixed reference temperature.

g. With burnout, in normal operation, pmpedance of R_{FUS} is high compared with that of the source of the input signal. Consequently, only a very small current passes through R_{FUS} and the effect of this current is cancelled by a d-c current produced by a small offset in the zero position of the instrument slidewire. On thermocouple burnout, the impedance of R_{FUS} is low compared with the very high or infinite resistance of an open primary element. On open circuit, the amplifier is referenced to the negative terminal of the CVU and will see a steady drive signal large enough to make the balance system drive full scale.

4. FILTER CAPACITORS

a. All instruments with type R and type S thermocouple ranges have a 2-mfd capacitor between each thermocouple input terminal and ground.

b. On all 2-second recorders and contact controllers, a 1-mfg capacitor is installed between the thermocouple actuations having upper scale limits of 1575°F (850°C) or higher.

REGULATED POWER SUPPLY
MEASURING SYSTEM

DESCRIPTION

PURPOSE AND USE

For potentiometers, the constant voltage unit maintains a stable output voltage across the resistive load of a measuring circuit; this causes a steady current to flow through the measuring circuit. Current is distributed in accordance with the resistance ratios of the various measuring circuit branches. Stability of the selected current through the calibrated slidewire insures the rated accuracy of instrument measurements. The constant voltage unit eliminates the need for a battery, a standard cell, and standardizing mechanism.

In resistance circuits, an uncalibrated constant voltage unit (also known as an ac-dc voltage unit) is used to convert a 120-volt a-c input to an output of 1.5 Vdc.

DESCRIPTION

DIMENSIONS. The unit is 5-1/8 inches high and 2-1/4 inches wide.

MOUNTING. The unit is usually mounted on an interior wall of the instrument case.

CONSTRUCTION. Components are mounted on a printed wiring board and enclosed by a metal cover. Output voltage, current, resistive load, input voltage and frequency are specified on a label inside the cover.

OPERATION

The circuit consists of an a-c to d-c power supply and a highly accurate two-stage voltage regulator. High output stability with large input voltage variations is achieved by the use of two cascaded zener diode circuits. Stability during ambient temperature variations is accomplished by use of a temperature-compensated reference zener diode for the second stage.

The voltage output of this unit for a constant load is virtually unaffected by variations in line voltage or ambient temperature. The equivalent resistance of the standard measuring circuit will vary by approximately ±2 ohms, depending on the value of the reference junction compensation resistor R_{rj}; the current from the constant voltage unit, however, will be virtually unchanged. In potentiometers, this unit will maintain an output voltage within ±0.15% of its rated output voltage.

In resistance circuits, with 1,000 ohms equal to 1% of load, the d-c output is 1.7 ±0.3 volt. The output current is six milliamperes.

134-0008-150

SOLID STATE AMPLIFIER

DESCRIPTION

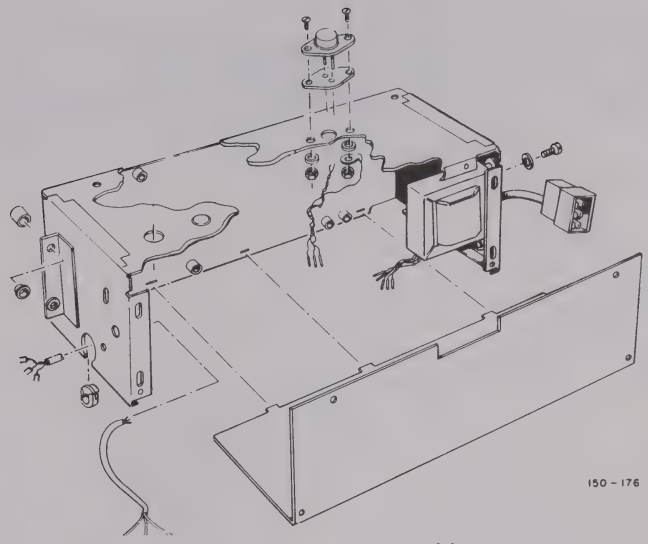


Figure 1. Solid State Amplifier

1. PURPOSE AND USE

The continuous balance solid-state amplifier receives an error signal (difference between input signal and measuring circuit feedback signal) and amplifiers it to drive the balancing motor. Direction of motor drive depends on the phase relationship between line voltage reference and amplifier output voltage.

2. SPECIFICATIONS

Ambient Temperature Limits at Instrument	Rated: 59° to 104°F (15° to 40°C) Extreme: 16° to 140°F (-90° to 60°C)
Source Impedance	
Spans less than 5 MV	40K ohms minimum
Spans 5 MV or greater	200K ohms minimum

Stray Rejection	
Normal mode	60 Hz: 0.5 x span 50 Hz: 0.2 x span
Common mode	60 Hz: To 120 volts RMS 50 Hz: To 50 volts RMS DC: 240 x span to 240 volts maximum
Dead Zone	Sensitivity to input signals greater than 0.1% of full scale.

SLIDEWIRE **DESCRIPTION**

1. GENERAL.

The slidewire assembly (Fig. 1) is attached to the lower section of the slidewire housing. The upper section may be separated to permit access to the mechanical zero adjustment (eccentric cam) connected to the underside of the slidewire form. The eccentric cam is used to vary the longitudinal position of the slidewire with respect to the contactor assembly.

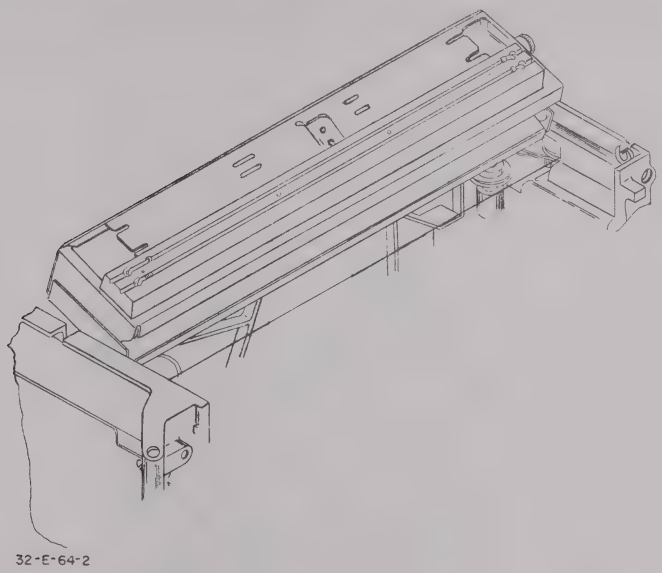


Figure 1, Straight Slidewire Assembly

2. CONSTRUCTION

The slidewire assembly consists of two resistance windings mounted on a molded form. One winding serves as a resistance in the measuring circuit, the other is wound directly on an uninsulated copper mandrel and serves as the collector. The feedback voltage of the measuring circuit is developed across the resistance winding. Although temperature gradients can exist between the various slidewire circuit connections, using the same resistance wire for the collector winding prevents the introduction of thermocouple effects since:

1. The slidewire terminal connections are copper to resistance wire junctions of opposite polarity and at one temperature.

2. The wiper arm contacts are noble metal to resistance wire junctions, of opposite polarity and at one temperature.

3. The thermocouples formed by contacts and resistance wires cancel because they are equal and of opposite polarity.

SINGLE SPEED CHART DRIVE MECHANISM

DESCRIPTION

1. GENERAL

The single speed chart drive mechanism consists of a gear train driven by a synchronous motor to produce the basic chart speed specified. Two of the gears in the gear train (gears A and B in fig. 1) are removable, permitting field conversion to 1-1/3, 2, 3, or 4 times the basic chart speed by installing the alternate change gears from the standard set provided. In addition to the standard set, an alternate change gear set is available to obtain factors of 1-1/5 or 3-1/3 times the basic speed, and a special set is available for conversion to 6 times the basic speed.

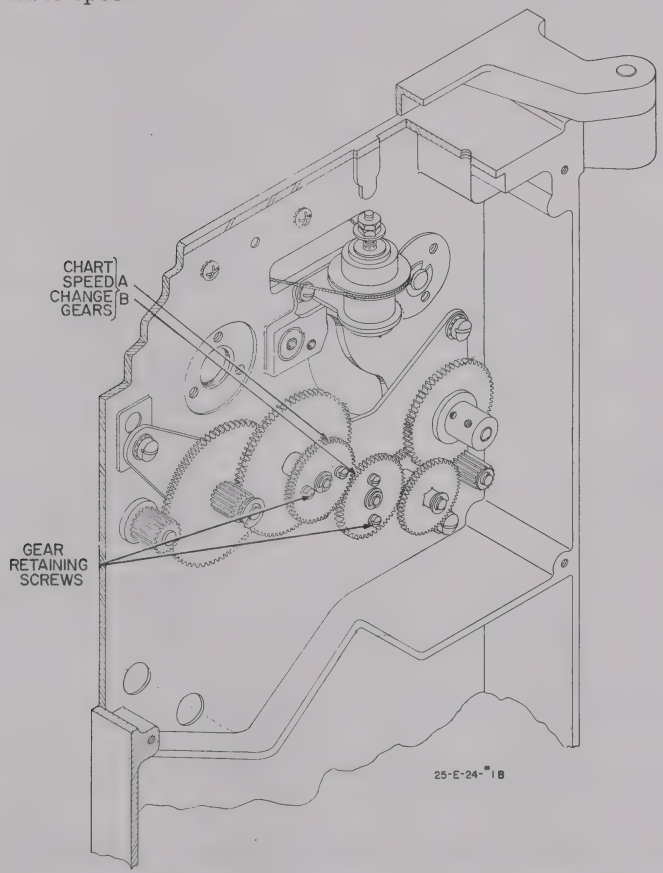


Figure 1. Chart drive gears, single speed mechanism.

2. CHANGING CHART SPEED

The change gears are mounted (on single record instruments) in the lower section of the left sideplate of the chassis or (on multirecord instruments) on top of the center casting. Procedures for installing the standard and the special gears are given in paragraphs a and b, respectively.

a. Standard Change Gears

(1) Remove the gear retaining screws and lockwashers from gears A and B (fig. 1) and remove these gears from the assembly.

(2) Place the new gears in positions A and B as selected from Table I. The gears are stamped with the number of teeth listed in the table.

Example: To obtain a chart speed of three times the basic speed, install the gears listed in Table I in the row for three times the basic speed; that is, the 72T gear in position A and the 48T gear in position B.

(3) Replace the lockwashers and the gear retaining screws.

TABLE I

CHART SPEED CHANGE GEARS

Desired Chart Speed	Change Gears Installation		Remarks
	Position A	Position B	
Basic (slowest) 2 times basic 3 times basic 4 times basic 1 1/3 times basic	40T 60T 72T 80T 48T	80T 60T 48T 40T 72T	This set always supplied with single speed chart drive mechanisms. (Change gear service replacement set 369701-1)
1 1/5 times basic 3 1/3 times basic	45T 75T	75T 45T	This set supplied only with optional variations 006,007, or 008. (Service replacement set 369701-2)
6 times basic	90T	30T gear and 18T pinion assembly	This set supplied only with optional variation 136. (Service replacement set 369701-3)

b. Special Gears for 6:1 Ratio

(1) Remove retaining screws and lockwashers from gear A and remove this gear from the assembly.

(2) Remove external cotter and washer from gear B and remove the gear B and pinion assembly.

(3) Place alternate gear and pinion assembly (stamped 30T) in the B position and secure with washer and cotter.

(4) Install alternate gear A (stamped 90T), using the two lockwashers and retaining screws.

LIMIT STOPS

DESCRIPTION

1. GENERAL

a. Auxiliary stops are mounted on the drive gear to limit carriage travel when operation pens are installed.

b. A stop is mounted in position A of Figure 1 to limit carriage travel at the right end of the scale when a right-hand operation pen is installed; a stop mounted at position B limits travel at the left end for a left-hand pen. When operation pens are installed at both ends of the scale, both stops will be installed.

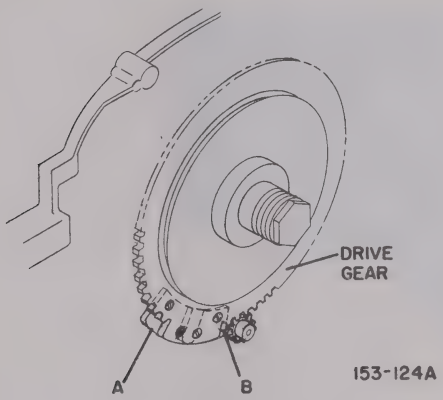


Figure 1. Limit Stops on drive gear.

c. These stops limit instrument span; carriage travel has been factory adjusted (see Table I).

TABLE 1

Instrument	Range of Carriage Travel (% of Full Scale)		
	W/Right-Hand Operation Pen	W/Left-Hand Operation Pen	W/Both L-H & R-H Operation Pens
Single-Pen	0-95%	5-100%	5-95%
Multipoint	0-90%	10-100%	10-90%

NOTE. Stops for multipoint instruments are slightly longer than those shown in Figure 1.

d. Stops are not adjustable. If it becomes necessary to adjust carriage travel, refer to the Service Section covering alignment.

1. GENERAL

a. Contact control components are located on the rear of the chassis (figure 1). A mechanical differential mechanism associated with both the process variable and the control index will operate a mercury switch assembly at the set point of the index, as selected from the front of the chassis.

b. Control forms 020, 021, 024, 025, 027, and 028 provide two-zone control; forms 031 and 036 provide three-zone control.

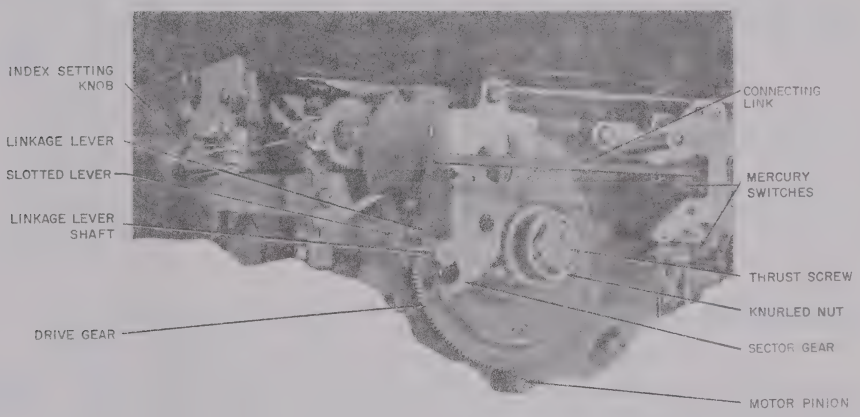


Figure 1. Rear View of Strip Chart Chassis (Single Record Contact Controller with Single Mechanism)

c. Control forms 021, 025, and 031 incorporate integrally mounted mercury plunger relays to permit switching higher current loads than the other control forms. See Table I for current ratings.

TABLE I

Control Form	Contact Capacity (Amps) Non-inductive Load			
	Volts ac		Volts dc	
	120	240	120	240
020, 024	1	1/2	1	1/2
027, 028, 036	10	5	5	2
021, 025, 031	30*	20	5	2-1/2

*Internal mercury relay.

2. TWO-ZONE CONTROL FORMS

a. Control forms 020, 021, and 027 each have one single-pole, single-throw mercury switch to provide simple on-off control of a single load (see figure 2A). The controlled load is on (energized) in Zone 1 and off (deenergized) in Zone 2. Switching action occurs at the index. The switch breaks contact as the process changes upscale from Zone 1 to Zone 2, and makes contact as the process changes downscale from Zone 2 to Zone 1.

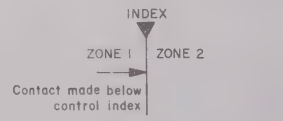
CAUTION: One-ampere mercury switches should be used only on applications requiring more than normally sensitive control action; these switches should not be used under conditions where they will be subjected to vibration or rapid cycling. Either condition can cause chatter of load contactors. Ten-ampere switches are recommended for such applications.

b. Control forms 024, 025, and 028 have two mercury switches mounted on the same switch deck and wired to the terminals to provide single-pole, double-throw switch action. Two loads can be controlled, one load in each zone (see figure 2B). Zone 1 is below (downscale of) the index and Zone 2 is above (upscale of) the index. With the process below the index, Load 1 in Zone 1 is off (deenergized), and Load 2 in Zone 2 is on (energized). Switching takes place at the index. When the process changes upscale to the index, Load 1 is switched on and Load 2 is switched off. When the process changes downscale to the index, the loads are switched back to the original condition. The adjustment provided permits overlap of the switching action, so that if switches are improperly adjusted, it is possible for both loads to be energized at the same time.

3. THREE-ZONE CONTROL FORMS

a. Control forms 031 and 036 have two mercury switches wired independently to provide break-before-make switching action. Zone 1 is on the left; Zone 2, a "neutral" zone where neither load is actuated, is in the center; and Zone 3 is on the right. The index is at the junction of Zones 2 and 3 (figure 3).

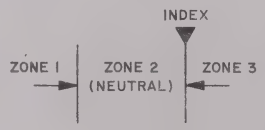
b. Unless otherwise specified on the order, width of Zone 2 is factory adjusted to 2% of full scale. Maximum width of Zone 2 is 2-1/2% of full scale. Zone width can be readjusted in the field by moving the mercury switch mounting clips (see SERVICE).



(A) Control Forms 020, 021 and 027

(B) Control Forms 024, 025 and 028

Figure 2. Two-Zone Control



150-61

Figure 3. Three-Zone Control (Forms 031 and 036)

INSTRUMENT INSTALLATION

1. UNPACKING

a. Open the shipping container and remove the packing material which covers the instrument.

b. Remove the packaged accessory equipment; each container is tagged or stamped with a part number which designates the items contained.

c. Open each container and check for the items listed.

d. Lift the instrument out of the shipping container.

e. If the instrument is a recorder, remove the charts supplied from the shipping container.

2. LOCATION

a. Select an area which is as close as practicable to the process variable.

b. The selected area should be clean and dry and have a relatively stable temperature. The ambient temperature should be within the instrument design limits.

c. Allow sufficient clearance at the rear of the instrument to permit access to all external connections. Allow sufficient clearance at the front of the instrument for observation and maintenance. Front clearance should permit the door to open 120 degrees and the chassis to swing out 155 degrees.

d. Vertical Scale Precision Indicators require sufficient front clearance to permit withdrawing the chassis without obstruction.

3. MOUNTING

a. GENERAL

(1) Mounting dimensions of the case are given on the drilling dimensions diagram included in this instruction manual. The accessory kit includes hardware for either flush or surface mounting. Alternately, strip chart instruments are supplied, when specified, with an optional kit containing laboratory feet for bench mounting.

(2) Some components are fastened to prevent damage in transit. Do not untie these components until installation is complete.

CAUTION: To obtain best performance the instrument should be mounted in a normal position (with the door glass in the vertical plane). Users who mount the instrument in other than a vertical position do so at their own risk.

b. FLUSH OR SURFACE MOUNTING Mount the instrument at a convenient height; 57 inches from floor to center line is suggested. Mount the instrument upright and as level as possible. Tighten all mounting bolts evenly, otherwise the case may be distorted and the strain may affect instrument operation.

c. BENCH MOUNTING (strip chart only) Remove the two lower surface mounting brackets. Use these to install the laboratory feet. Note that for proper support, the feet must face toward the front of the instrument.

4. DOOR ALIGNMENT

Occasionally in mounting the instrument the door will become misaligned. It should be centered with respect to the case. To check, open and close the door a few times. If it rubs or sticks, loosen the two screws in each hinge, realign the door so there is sufficient clearance between door and case on all sides, then tighten the screws.

5. ADJUSTING CHASSIS LATCH

Check the adjustment of the chassis latch to correct for any misalignment between the chassis and the case. The latch pin on the chassis (Figure 1) should not touch the latch plate on the case as the chassis is swung into place. If it does, proceed as follows:

a. Swing the chassis out of the case and loosen the two screws which hold the latch plate to the case.

b. Adjust the latch plate until the guide pin clears the slot in the plate, and tighten the two screws.

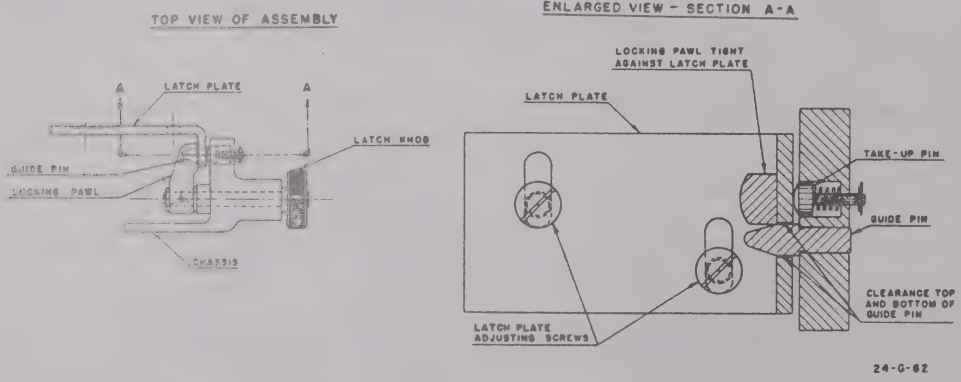


Figure 1. Chassis latch

6. ELECTRICAL CONNECTIONS

a. General. The external wiring diagram attached to this instruction shows external electrical connections. The wiring diagram is self-explanatory; however, the following precautions should be observed.

(1) All electrical connections are made to terminal blocks mounted in the rear of the case. These connections are identified by designations on terminal block marker strips.

(2) Connect the instrument ground (GND) directly and separately to a suitable ground, as recommended by the National Electrical Code. A cold water pipe is frequently an adequate ground; however, check the suitability of a particular pipe before using it. If the pipe has a shallow location or uses fiber connectors it may prove unsatisfactory. No. 14 B & S gage copper wire is recommended for the ground connection.

WARNING: Do NOT connect the "GND" terminal to the neutral a-c line terminal.

(3) Connect power leads as follows:

(a) Instruments with optional 240-volt transformer: connect to terminals L1 and L2.

(b) Instruments without optional transformer: connect to the AC LINE terminals. Check the line to determine its neutral (grounded) side and connect it to the NEUTRAL terminal.

(4) If rigid conduit is used, connect it to the case with approximately 18 inches of flexible conduit to relieve strains on the instrument case.

(5) To minimize entrance of dust and dirt, close all unused conduit holes with the plug buttons supplied with the instrument.

(6) Install the primary element and connect its leads to the instrument input terminals as shown in the external wiring diagram.

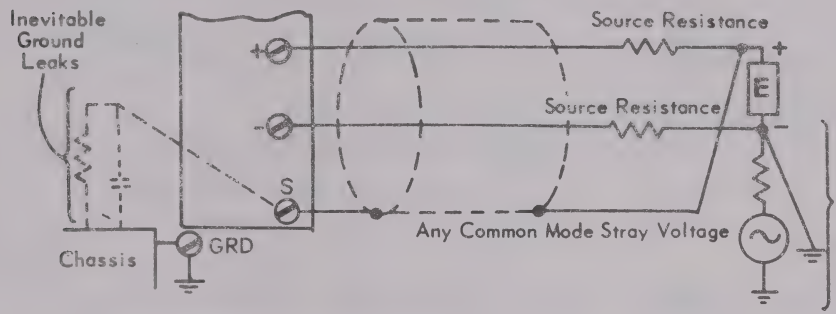
b. Optional Equipment. Optional equipment may require additional electrical connections. If so, information pertinent to the selected option is included in this manual.

SHIELD **INSTALLATION**

1. OBJECT

To have the minimum stray current possible flowing through the source resistance (total resistance of the external circuit, looking out from the instrument input terminals). The best way to reduce the effect of stray is to have as low source resistance as is practical.

In instruments with optional checking terminals, the shield terminal is factory-connected internally to the plus (+) input terminal of the measuring circuit unit. Therefore (although the following explanation applies), selection of shield connections is not available.


Inevitable Ground Leaks
+
-
S
GRD
Chassis
Source Resistance
Source Resistance
E
Any Common Mode Stray Voltage
Any Common Mode stray voltages at the source are "shorted", retaining "single-ground" concept. This can only be done if the stray source has sufficient impedance so that it can be grounded without destructive effects.
150-163

3. TYPES OF INTERFERENCE STRAY

a. NORMAL MODE

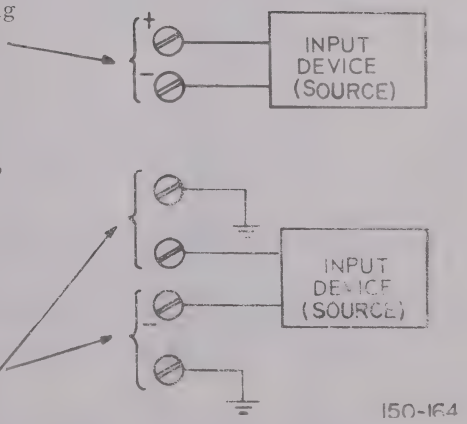
(1) That interference appearing as a voltage between or in series with the input terminals.

(2) Also called differential mode, transverse, series, and loop.

(3) Attenuated by amplifier input filter.

b. COMMON MODE

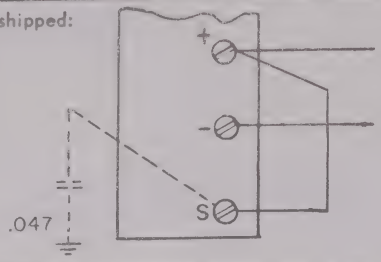
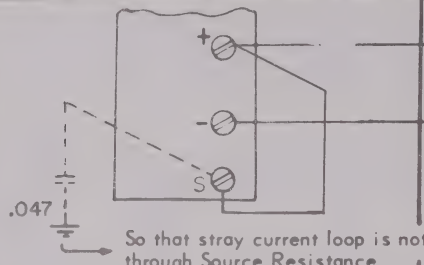
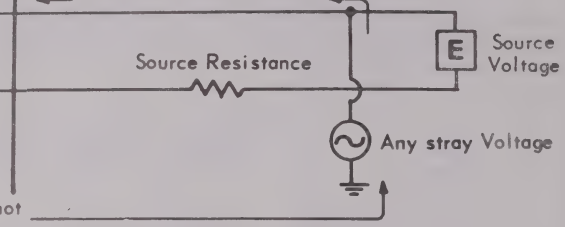
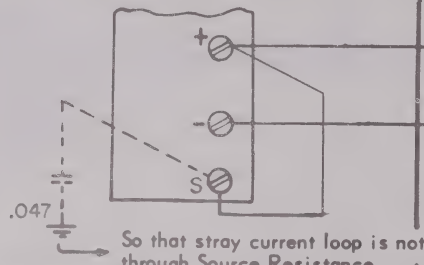
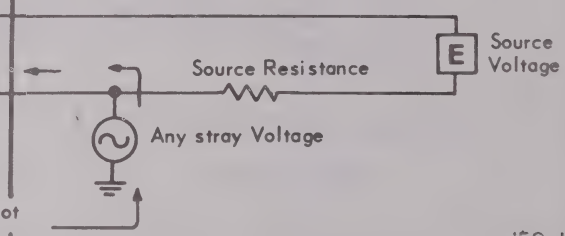
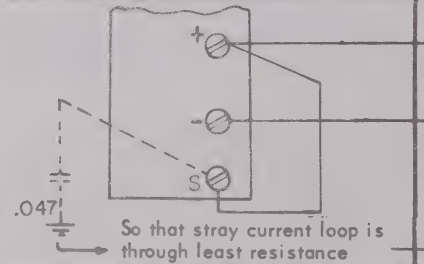
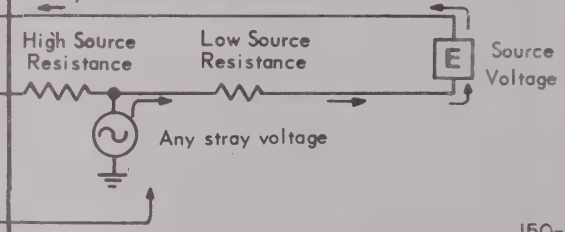
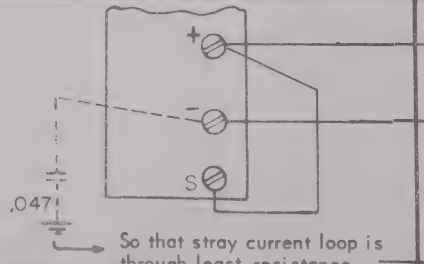
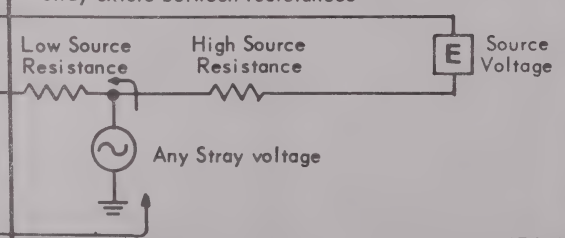
(1) That interference appearing as a voltage between input terminals and ground.



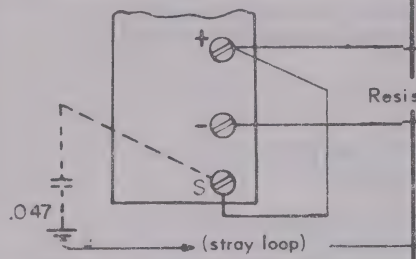
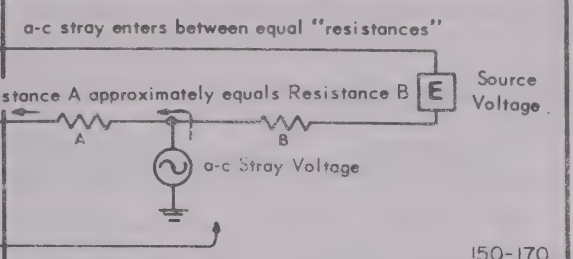
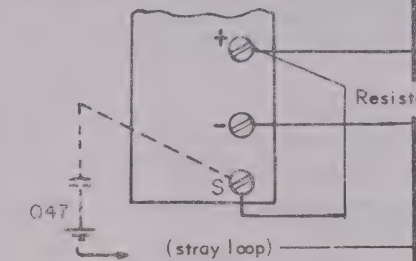
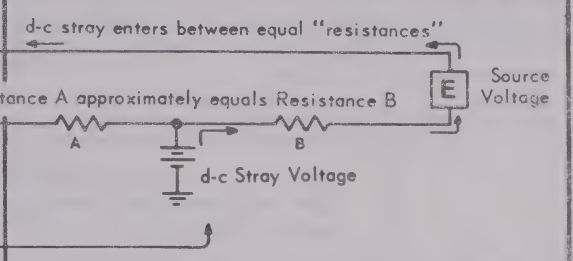
150-164

(2) Also called longitudinal (or stray-to-ground).

(3) When can't be rejected as shown in IDEAL SITUATION, shield jumper supplied on customer terminal panel (TB) is used to minimize the conversion of Common Mode to Normal Mode.

4. CONNECTION REQUIRED	FOR THESE CONDITIONS
As shipped: 	Whenever source impedance or resistance is less than 200 Ω, stray current will not affect instrument accuracy ratings. Above 200 Ω, accuracy ratings are affected but can be minimized as shown in conditions below. 150-165
 So that stray current loop is not through Source Resistance	Stray enters positive side of source.  150-166
 So that stray current loop is not through Source Resistance	Stray enters negative side of source  150-167
 So that stray current loop is through least resistance	Stray enters between resistances  150-168
 So that stray current loop is through least resistance	Stray enters between resistances  150-169

SHIELD **INSTALLATION**

CONNECTION REQUIRED	FOR THESE CONDITIONS
	
	
Try both, connect to the terminal that gives best results.	UNKNOWN

5. CONSIDERATIONS

CAUTION

The metal case of the amplifier and the measuring circuit unit in this instrument are connected to the input terminals so the shields are at stray potential. A shock hazard will exist if stray signals of 30 volts or higher (ac or dc) are incountered; heed the warning label in the amplifier!

a. In this instrument d-c stray is more critical then a-c, especially in high temperature and high humidity ambients.

b. Any stray voltage generated by d-c leakage through the signal source will be algebraically added to the input signal.

c. This instrument has a guard shield which is returned to the instrument ground via a 0.047 mfd capacitor. This capacitor is required to attenuate self-generated common mode stray voltage. It may be increased in value as application conditions require.

d. Do not confuse "instrument-ground (GND) which ties the chassis and case to an earth connection (water-pipe-ground or earth-ground) with "signal-ground". We are defining "signal-ground" as "shield". "SHIELD" is grounded only in IDEAL SITUATION, where Common Mode source can be grounded without adverse effects (recommended as good electrical practice).

6. EXTREME PROBLEMS

a. **FOR D-C STRAY.** Keep instrument ambient temperature down, and atmosphere dry, free of moisture, steam, and condensation.

b. **FOR A-C STRAY.** When shield terminal cannot be used effectively as shown above, try a capacitor across input terminals when there is source resistance to short-circuit a-c Normal Mode. A pair of back-to-back Tantalum capacitors are preferred by some. Experiments can be made with filter circuits at the input terminals using values in relation to the actual input signal and the magnitude of the stray.

> Remember that any components added to the input will affect the dynamics of the servo, generally slowing the balancing speed.

STRIP CHART RECORDER OPERATION

1. PLACING IN OPERATION

a. Check all connections. Electrical, pneumatic (when applicable) and primary element connections are specified in the installation procedures.

b. Recheck to be sure all shipping fasteners have been removed.

c. Install the chart and place the recording system in operation as described in the appropriate sections.

d. Switch on power to the instrument and allow it to warm up for at least 30 minutes to be sure the measurements obtained are within the calibrated accuracy of the instrument.

e. Switch on power to the chart drive system when recording is required.

2. OPERATION AS AN INDICATOR

a. SINGLE RECORD INSTRUMENTS

(1) Move balancing motor lead normally connected to terminal B, to terminal G on chassis power block.

(2) Use manual pen lifting device to raise pen off chart.

NOTE: On two pen and extended range instruments be sure to position the pens so they will pass each other without interference.

b. MULTIPOINT INSTRUMENTS

(1) Non-controllers. To operate as indicator on selected point, wait until preceeding point has printed, then switch off power to the chart drive system as instrument starts to rebalance on selected point. Be sure print wheel is off chart.

(2) Controllers. These instruments are not normally operated as indicators. When indication is required, move balancing motor lead normally connected to terminal B, to terminal G, on chassis power block, and proceed as described for non-controllers.

3. CALIBRATION

a. The instrument is adjusted, calibrated, and inspected before it leaves the factory; it is ready for use when it is received. However, because of changes in line voltage, input impedance, or other factors, sensitivity (gain) may require readjustment on initial startup (see Calibration section). Instrument calibration should be checked periodically as part of routine maintenance procedures.

4. SHUTDOWN

a. For relatively short shutdown periods, switch off power to the chart drive system, raise pen off chart (if necessary), but leave the instrument power switched on. This keeps the amplifier energized and eliminates the warm up period before placing the instrument back in service.

b. Switch off instrument power when necessary for servicing or for shutdown periods of one week or longer.

NOTE: Electron tubes should be energized continuously; subjecting them to frequent heating and cooling shortens their life.

5. RELATED PROCEDURES

a. If additional procedures are required to place the instrument in operation due to features and options supplied, they are specified later in this manual.

RESISTOR BURNOUT OPERATION

1. GENERAL.

a. This instrument is equipped with a resistor type burnout feature which protects the process from damage resulting from failure of most measuring circuit components or the primary element. The burnout signal is developed across a resistor located between the measuring circuit bridge and the amplifier. If a failure occurs, the burnout signal will cause the instrument indicator (or equivalent) to drive to its limit of travel.

b. The direction of drive may be either upscale or downscale depending on the type of burnout specified. Resistor type burnout may be supplied independently or in conjunction with amplifier type burnout.

2. CHECKING OPERATION.

Before placing the instrument in service it is desirable to check the operation of the burnout feature as follows:

a. Be sure the instrument power is turned off.

b. Rotate the main drive gear to set the indicator (or equivalent) at the 50% full scale position.

c. Disconnect the primary element at the input terminal panel.

d. Turn on the power to the instrument. The indicator should drive to the appropriate limit of travel.

e. If the indicator remains stationary or drives in the wrong direction check the measuring circuit (refer to Instrument Service Section).

1. INSTALLATION

The words RENEW CHART are printed at regular intervals on the last 48 to 96 inches of chart paper. Chart installation procedures are the same for all instrument models, except for the type of reroll tube used. If specified, a permanent wooden reroll bobbin is supplied which contains a chart saver device (spring clip on a retractable steel tape). If the instrument does not have the chart saver, the empty supply roll tube with gummed sticker attached) is used as the reroll tube. Chart installation procedures for instruments without the chart saver are given in figure 1. Chart installation procedures for instruments with the chart saver are the same with the following exceptions.

a. Discard the empty supply roll tube.

b. After winding the chart as shown in figure 1, position the chart so the pen will begin recording on the correct time line, then withdraw the spring clip from the wooden bobbin and attach it to the tapered end of the chart. Release the spring clip gradually allowing the steel tape to recoil and place the chart under tension.

2. REMOVAL

a. Press the used (rerolled) chart against the spring loaded reroll spindle, swing the right end forward, and remove the chart roll from the instrument.

b. Pull the chart plate down.

c. Press the empty supply roll tube and the metal tube to the left. Remove both tubes from the instrument.

1. Pull chart plate down.

2. Place empty supply roll tube (with gummed sticker attached) on reroll spindle..

3. Press metal tube to left, swing right end forward, and remove tube from instrument.

4. Slip new chart roll on metal tube and place tube on chart feed spindles so that chart unwinds from the bottom.

5. Taper free end of chart approximately 45° as shown .

6. Feed chart over this guide bar and under the chart drum.

7. Run chart over chart drum and under the tear-off strip.

8. Swing chart plate up.

9. Keep chart taut and turn this knob to carry chart down and over the chart plate.

10. Attach tapered end of chart to reroll tube with gummed sticker.

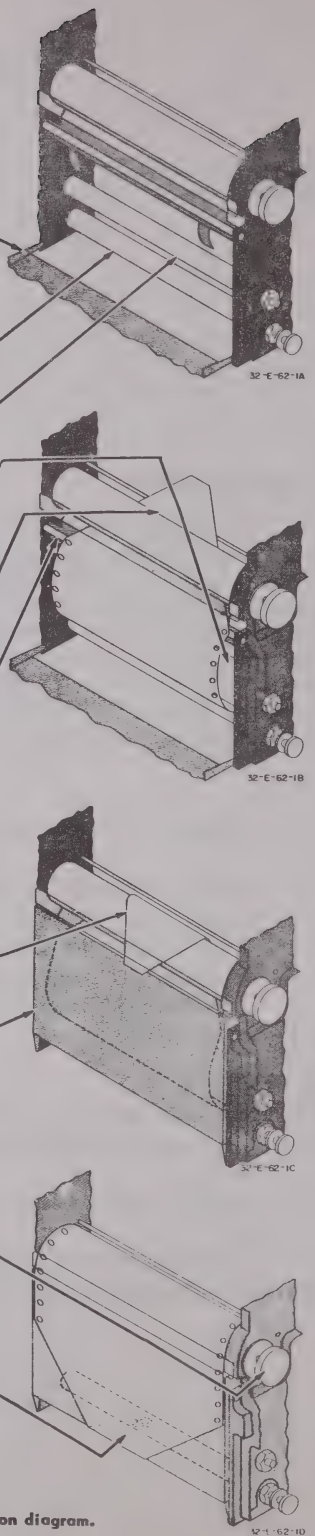


Figure 1. Chart installation diagram.

1. FILLING AND STARTING PEN

This instrument is supplied with a capillary type recording pen and a separate ink reservoir. This design features clear and reliable recording in conjunction with a large ink supply. In normal use, the reservoir should require only infrequent filling, depending on the speed of the recording system. Fill and start the pen as follows:

a. Remove the wire clamp that secures the pen during shipment.

b. Pry out the plug from the top of the reservoir (supply) bottle. Using the bottle of ink supplied with the instrument, fill the supply bottle to the curve in the neck. Do not overfill. Reinsert the plug.

CAUTION: Do not use any ink other than the type supplied with the instrument.

c. Force ink to the pen tip (refer to fig. 1).

(1) Raise pen tip off chart by means of the pen lifter.

(2) Place index finger over plug hole in ink supply bottle and squeeze bottle to force ink through system to pen tip. Force enough ink from tip to be sure that no air bubbles remain in tubing.

NOTE: Remove finger from plug hole before releasing pressure on the squeeze bottle to prevent sucking ink back from pen tip.

d. Prime the pen body:

NOTE: This priming operation is required only when starting the pen for the first time, or when the ink supply is permitted to run dry. To eliminate the need for priming the pen, refill the reservoir bottle before the ink supply is completely exhausted (described in step 1, b, above).

(1) Lower pen tip to chart.

(2) Loosen vent screw on side of pen body.

(3) Place finger over plug hole in supply bottle and gently squeeze until pen body is half full of ink. If this level is exceeded, ink will run out of the vent.

(4) Release squeeze bottle, tighten vent screw, and check that ink does not cover vent screw. Pen is now ready for operation.

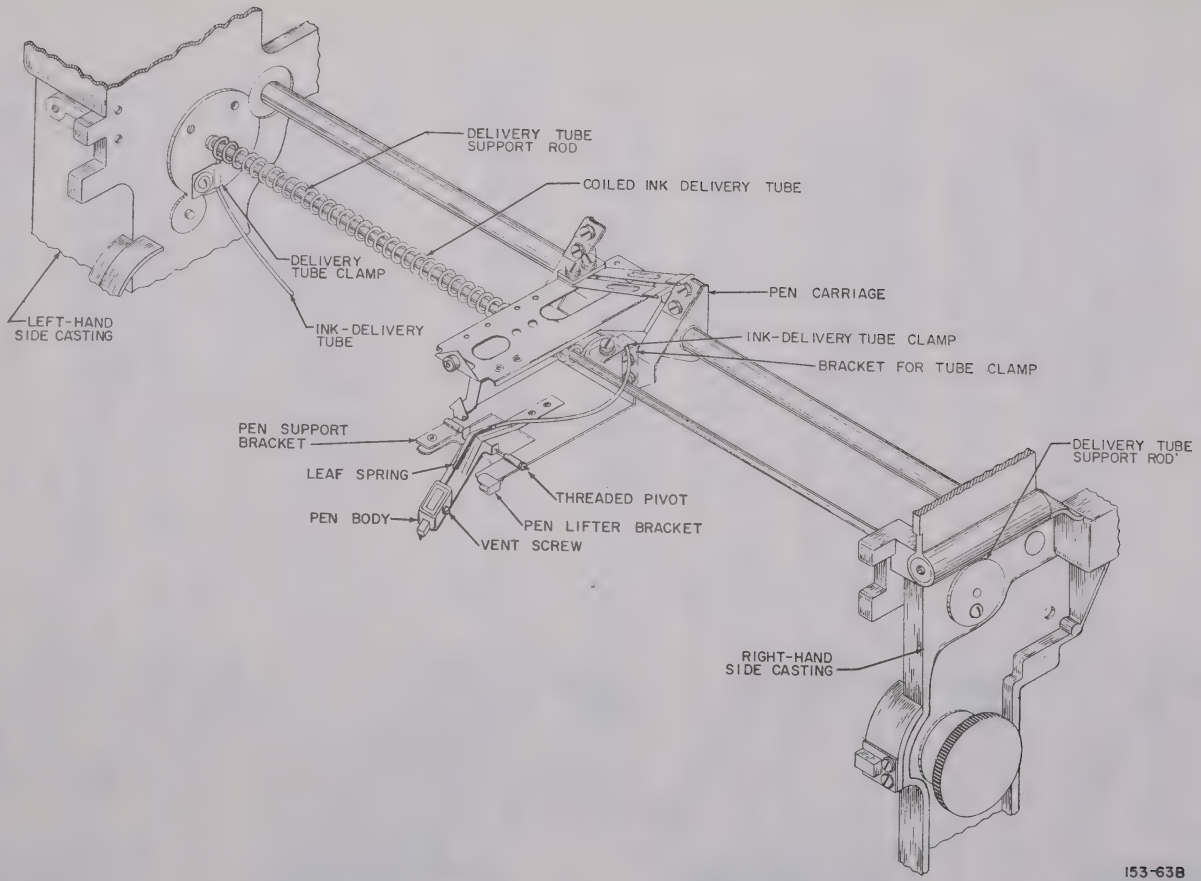


Figure 1. Pen Carriage Assembly

2. ROUTINE PEN CLEANING

a. The pen tip should be cleaned every month by forcing a stream of ink through the system as follows:

(1) Use manual pen lifter bracket to raise pen off chart.

(2) Place a paper towel or blotter under pen tip.

(3) Place finger over plug hole in supply bottle.

(4) Squeeze supply bottle until a stream of ink is forced through pen tip.

b. This routine cleaning should remove any paper fibers and bits of dust which have collected at the pen tip. If this material were permitted to accumulate, it could prevent the normal flow of ink and cause skipping.

NOTE: If the pen has stopped writing, or if skipping occurs, check the ink supply bottle. If it contains sufficient ink, check the ink level in the pen body. The ink should come up to, but not cover, the vent plug. If the ink level is above the vent plug, reduce the ink supply by placing a blotter or paper towel under the pen tip and loosening the vent screw. Ink will bleed out of the pen tip or the vent screw. When the ink reaches the proper level, tighten the vent screw. If the ink level is more than 1/16-inch below the center line of the vent screw, prime the reservoir as previously described.

3. CLEANING PEN BODY

If the pen has stopped writing or if skipping occurs, and if the routine checks and cleaning procedure described above are not effective in restoring proper pen action, then the pen body should be cleaned as follows:

a. Squeeze the supply bottle to remove air, place a finger over the plug hole in the supply bottle, open the vent screw on the pen body, and release the supply bottle to extract ink from the system. Repeat until all ink is returned to the supply bottle.

b. Remove the pen body from the pen carriage assembly.

c. Fill a spare supply bottle with detergent solution and connect this to the capillary on back of the pen body.

NOTE: A solution ratio of one teaspoonful of a low level controlled suds detergent to a gallon of water is recommended.

d. Close the vent screw.

e. Squeeze the supply bottle, forcing the solution through the pen body and tip. If a steady stream of solution comes through the pen tip, the pen is clean. If an irregular or dispersed flow of solution occurs, the pen should be cleaned as follows:

(1) Dislodge any foreign matter in pen tip by the insertion and removal of a fine wire (.005 inch diameter).

(2) Remove vent screw on pen body.

(3) Connect supply bottle, filled with detergent solution, to pen tip.

(4) Hold pen body so that vent opening is downward, and squeeze supply bottle.

(5) This reverse flushing of pen body is necessary to expel any foreign matter dislodged by wire. Do not attempt to operate pen without flushing since clogging will probably recur.

(6) Rinse the pen body with water, in a similar manner.

NOTE: All of the detergent solution must be removed in order to prevent contamination of the ink. A small amount of detergent will reduce the surface tension of the ink and cause feathering or blurring of the record. Excess water will be removed from the system as part of the priming procedure.

(7) Reinstall vent screw. Install the pen body on the pen carriage and prime the system as previously described.

4. ROUTINE OPERATION AND CHART CHANGING

a. Lift the pen from the chart by means of the manual pen lifter.

b. Change the chart.

c. Replace the pen on the chart; it should start writing at once. If it does not, gently squeeze the ink supply bottle while holding a finger over the plug hole. This forces ink out of the pen tip and it should start writing.

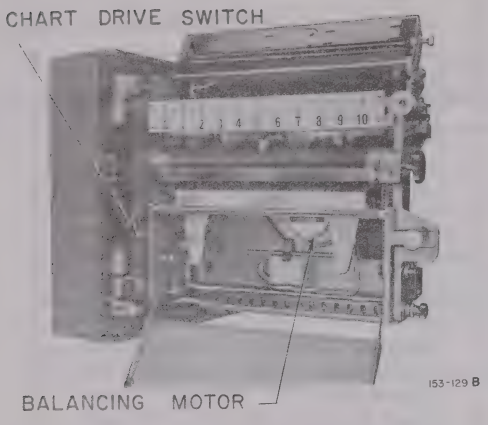


Figure 1. Chassis, Front View.

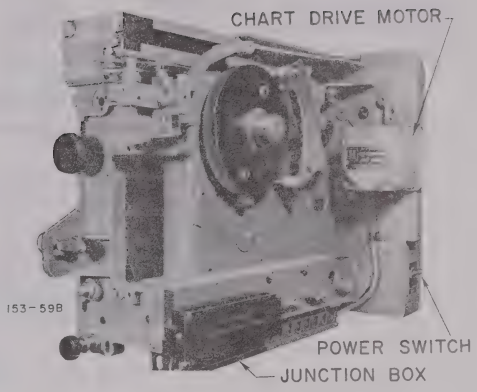


Figure 2. Chassis, Rear View.

1. SWITCH FUNCTION

a. The function of the chart drive switch is dependent upon how balancing motor is wired to junction block on rear of chassis. (See Table 1, and Power Circuit Wiring Diagram included with this manual).

TABLE 1

BALANCING MOTOR CONNECTIONS

Balancing Motor (Part No.)	Junction Block Terminal			
	D	E	H	B or G
362479-1 362479-2 362479-3 362479-4 362479-5 362480-	Red	White Yellow	Green	Yellow White

b. The single record instruments and multi-record Controllers have their balancing motor lead connected to "B"; the multi-record non-controllers have their balancing motor lead connected to "G". Advantages of either position are given below.

Balancing Motor Lead on Terminal	Power Switch	Chart Switch	Instrument Condition
B	OFF	ON	Instrument completely off
	ON	ON	Instrument completely on
	ON	OFF	Chart motor off, balancing motor off, amplifier on; this is "STAND BY OPERATION" permits "warm-up" without chart running.
G	OFF	ON	Instrument completely off
	ON	ON	Instrument completely on
	ON	OFF	Chart motor off, balancing motor on, amplifier on; INSTRUMENT OPERATES AS AN INDICATOR- to use this way, lift pens from chart to avoid possible damage to them.

CONTROL SYSTEM STARTUP

a. Connect the control circuit as shown on the external Wiring Diagram included in this instruction. Do not exceed the contact ratings shown on this diagram.

CAUTION: Wiring diagram shows zone switching action for direct reading ranges. Zone switching action is NOT REVERSED on instruments with reversed ranges. In this instance, modify the wiring connections to suit the reversed range control requirements.

NOTE: For circular chart recorders, Zone 1 is always toward the inner edge (hub) of the chart. For circular scale indicators, Zone 1 is always counterclockwise from the set point index. For strip chart recorders, Zone 1 is always toward the left-hand side of the chart.

b. Adjust the set point index to the desired value by turning the set point index knob. Dual-index (strip chart) controllers have an individual knob for each index.

c. The control switch (or switches) are actuated through a differential mechanism. Switches are factory-set to provide the control action ordered. If desired, operation can be checked as described in the service section for contact control components.

d. Energize the instrument (allow time for amplifier tubes to warm up). Close the external control switch (if used). The instrument will now operate automatically to control the measured variable at the selected set point.

STRIP CHART RECORDERS

MAINTENANCE

1. GENERAL

a. Following a routine inspection and maintenance program will insure maximum instrument performance and should reduce servicing requirements to a minimum. Time and trouble can be saved by arranging for one of the maintenance agreements described on the inside front cover of this instruction: this will guarantee expert, economical care, and insure maximum life and efficiency from your instrument.

b. Some maintenance can be performed with the instrument in service: other procedures, such as performance checks, require a temporary instrument shutdown.

2. CHECKS AND PROCEDURES

a. Routine checks are tabulated in this section. Some procedures are given; others are cross-referenced to the section in which they occur. These procedures are recommended to supplement normal industrial cleaning procedures. Maintenance and Service sections on various components also include checks and adjustments for use in locating and correcting specific troubles.

b. The tabulated list covers only basic instruments. Procedures for servicing measuring and control system components, and optional equipment such as auxiliary switches, are given in separate sections included in this instruction for the variations ordered.

TABLE 1

ROUTINE MAINTENANCE CHECKS AND PROCEDURES

WHAT TO DO	WHEN	HOW
GENERAL		
1. Check performance.	1. Periodically	1. Check sensitivity: a. With the instrument at balance, manually turn the drive gear or equivalent (e.g., drive pulley) to move the indicator first upscale, then downscale 1-2% of full scale. Allow indicator to return to balance point and note position(s).

TABLE 1

ROUTINE MAINTENANCE CHECKS AND PROCEDURES (Continued)

WHAT TO DO	WHEN	HOW
		b. If the difference between the two balance points exceeds about 0.25% of full scale, increase amplifier sensitivity (see Service Section-Amplifier).
		2. Check damping -- Refer to Service Section-Measuring Circuit
RECORDING & INDICATING COMPONENTS		
1. Change chart.	1. When warning RENEW CHART appears on chart in use. If preferred, duration of chart at selected speed can be calculated for single-speed chart systems and replacements made on periodic basis.	1. Refer to Operation Section - Charts.
2. Clean scale.	2. As required.	2. Use a soft cloth with a soap and water solution to remove dirt, grease, and ink. Do not use alcohol base solvents which may attack the lacquer finish of the scale.

TABLE 1

ROUTINE MAINTENANCE CHECKS AND PROCEDURES (Continued)

WHAT TO DO	WHEN	HOW
3. Check pen(s) or print wheel.	3. See below.	3. See below.
a. Capillary pen with remote reservoir (including both pens of two-pen recorders)		a. Refer to Operation Section - Recording Pens(s).
(1) Check ink level, refill, prime.	(1) Correct ink Level if skipping or stoppage occurs. Refill as required. Prime for startup.	(1) See above.
(2) Clean pen tip.	(2) Once a month.	(2) See above.
(3) Clean pen body.	(3) Every 3 months, unless skipping or stoppage occurs and operation is not restored by correcting ink level.	(3) See above.
b. Heated stylus		
(1) Adjust rheostat.	(1) To narrow or widen recorded line; if burn mark appears on chart (setting too high).	(1) See above.
(2) Oil pen carriage bearings.	(2) Once a month.	(2) Oil lightly using either Type L-1* or equivalent high grade instrument oil.
c. Print wheel.		
(1) Re-ink, replace worn pads.	(1) As required.	(1) Refer to Operation Section - Print Carriage.
(2) Check printed record. Realign print wheel if pressure is uneven.	(2) Periodically.	(2) Refer to Service Section - Printing Components.

* *Honeywell* Part No. 30079329 (1 oz.), 30015261 (8 oz.), 30071042 (16 oz.)

TABLE 1

ROUTINE MAINTENANCE CHECKS AND PROCEDURES (Continued)

WHAT TO DO	WHEN	HOW
(3) Adjust follower arm spring.	(3) If instrument is operated in other than a vertical position.	(3) Refer to Service Section - Printing Components.
(4) Lubricate.	(4) Inspect once a month.	(4) Oil lightly as needed using Type L-1* or equivalent high grade instrument oil (see Maintenance Section - Printing Components.
4. Check alignment of recording system.	4. When record does not coincide with appropriate chart graduations.	4. See Service Section - Alignment.
5. Check chart drive system:		
a. Clean gears.	a. As required.	a. Use a stiff bristle brush and trichlorethylene. See illustration in Maintenance Section - Instrument or Chart Drive Mechanism.
b. Lubricate	b. Inspect once a month.	b. See oiling points in separate Maintenance Section - Instrument. Oil lightly as needed using either Type L-1* or equivalent high grade instrument oil.* NOTE: The chart motor is factory lubricated and does not need periodic oiling; however, the external drive pinion is not sealed and should be lubricated as part of the chart drive system.

*Honeywell Part No. 30079329 (1 oz.), 30015261 (8 oz.), 30071042 (16 oz.)

TABLE 1

ROUTINE MAINTENANCE CHECKS AND PROCEDURES (Continued)

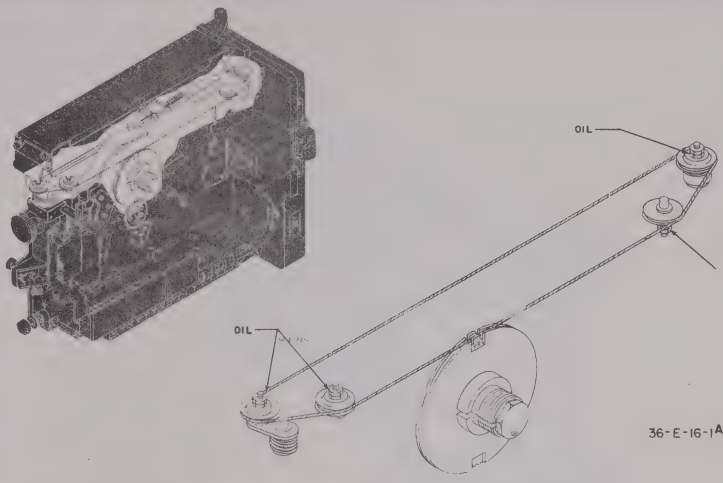
WHAT TO DO	WHEN	HOW
c. Inspect chart motor for wear, dirty bearings, overheating etc. Clean.	c. Check every 6 months. Clean as required.	c. Refer to Service Section - Motors.
5. Clean selector switch(es) - multipoint non-control instruments; single and multipoint controllers.	5. Once a month.	5. Refer to Maintenance Section - Selector Switch.
BALANCING COMPONENTS NOTE: If instrument has two balancing systems (e.g., 2-pen recorder) treat both alike.		
1. Clean drive gear.	1. As required.	1. Use a stiff bristle brush and trichlorethylene. See illustration in Maintenance Section-Instrument NOTE: The balancing motor is factory-lubricated and does not require periodic oiling.
2. Oil drive gear and all drive cable pulleys.	2. Inspect once a month.	2. See oiling points in separate Maintenance Section - Instrument. Oil lightly as needed using either Type L-1* or equivalent high grade instrument oil. NOTE: Do not oil slidewire drive cable. Wipe it off with a clean dry cloth to remove any oil or accumulated dirt.

*Honeywell Part No. 30079329 (1 oz.), 30015261 (8 oz.), 30071042 (16 oz.)

TABLE 1

ROUTINE MAINTENANCE CHECKS AND PROCEDURES (Continued)

WHAT TO DO	WHEN	HOW
3. Amplifier (tube or transistor type).		
a. Replace fuse.	a. As required.	a. Refer to Service Section - Amplifier.
b. Check tubes (if used). Replace weak or defective ones.	b. Once a month.	b. Refer to Service Section - Amplifier.
c. Adjust sensitivity.	c. Once a month (and after tube replacement).	c. Refer to Service Section - Amplifier, also to Service Section - Calibration for Quarter-Second Recorder.
4. Check slidewire and contactor assembly (standard straight or helical types).	4. Once a month.	4. Refer to Service Section - Slidewire.
NOTE: The Helipot used as a slidewire in the chart system of Function Plotters is totally enclosed and needs no routine maintenance. Do not move or disassemble it.		
a. Clean	a. As required.	a. See above.
b. Replace contactor.	b. When worn.	b. See above.
c. Check contactor pressure.	c. As required.	c. See above.
5. Inspect balancing motor for wear, dirty bearings, overheating, etc. Clean.	5. Check every 6 months. Clean as required.	5. Refer to Service Section - Motors.
6. Check and adjust damping (if supplied).	6. If instrument pen or print wheel consistently over or undershoots balance point.	6. Refer to Service Section - Measuring Circuit.



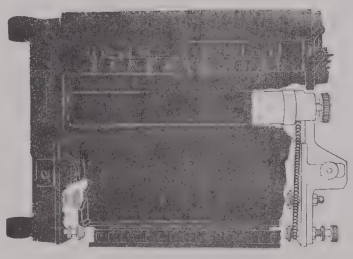
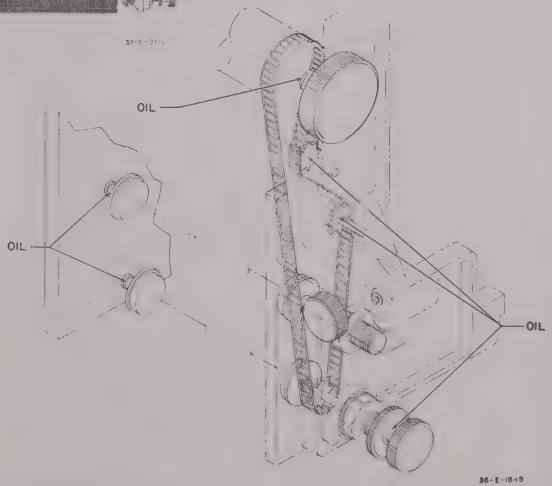
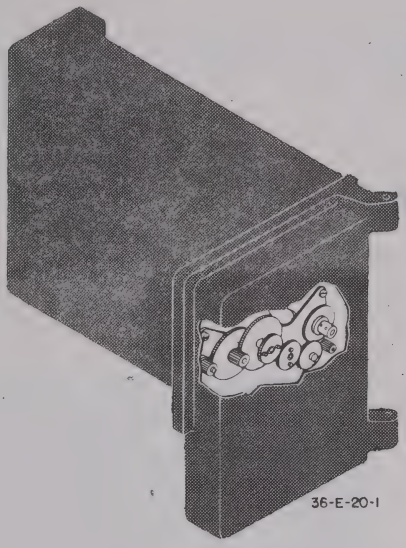
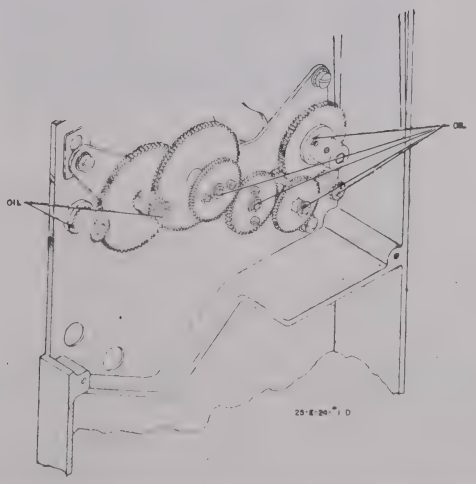


Figure 1. Lubrication diagram





Lubrication of Chart Drive Gears Single-speed Chart Drive -- Single-pen Recorders.



1. MERCURY SWITCH CONTROL UNIT

a. LUBRICATION.

(1) GENERAL. Lubricate control switch mechanism every month with type L-1 oil (included in instrument accessory kit) or any other high grade light oil.

(2) SWITCH MECHANISM ON BACK OF CHASSIS. (Figs. 1 and 2).

(a) Apply oil sparingly at points designated alphabetically:

A - linkage lever shaft bearing

B - switch mechanism bearing (not all such bearings are visible in either illustration)

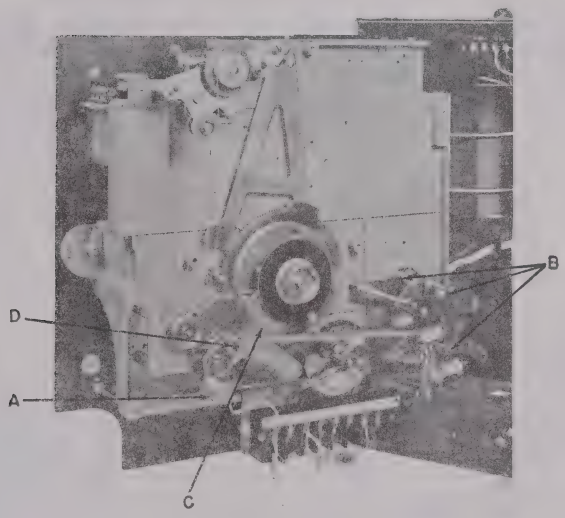


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Figure 1. Back of circular chart recorder chassis

C - hub of pen position sector gear and its retaining washer ("C" calls out sector gear, not the oil point).

D - linkage pivots

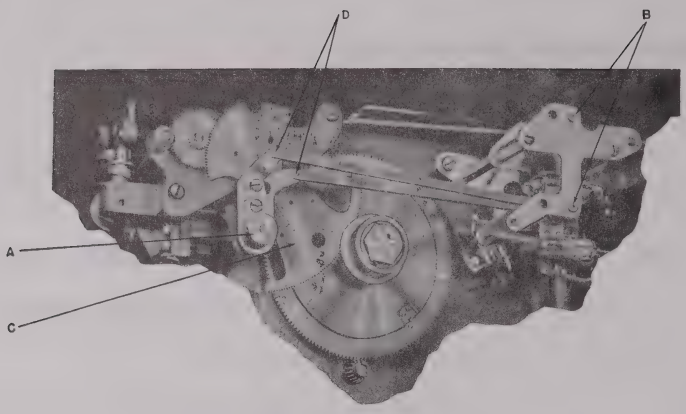


Figure 2. Back of strip chart recorder chassis

(b) Also apply oil to stud of roller on each driving lever (see fig. 3).

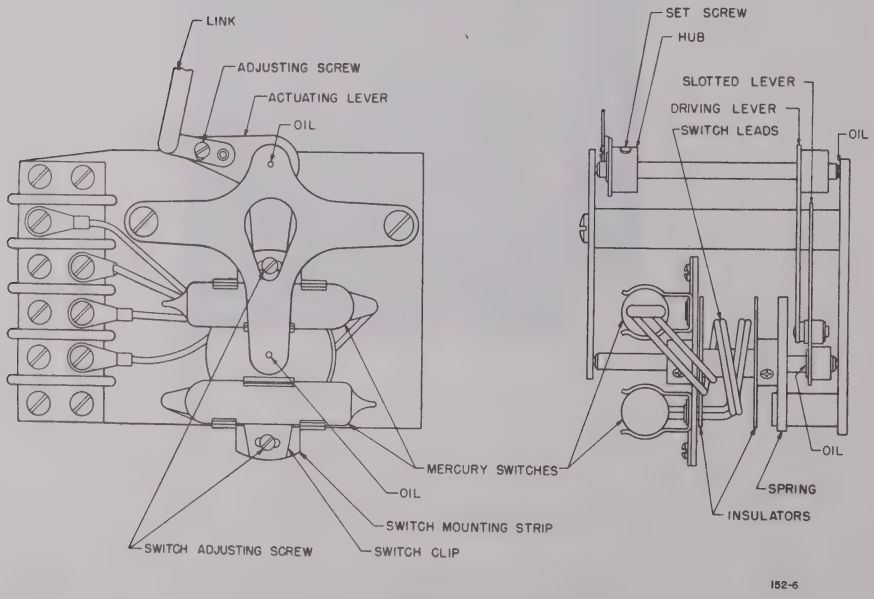


Figure 3. Switch assembly, front of circular chart recorder chassis

(3) SWITCH MECHANISM ON FRONT OF CHASSIS (fig. 3).

(a) Remove chart and chart plate.

(b) Apply oil sparingly at following points:

A - shaft bearings

B - stud of roller on driving lever

b. **SWITCHES.** Cloudy appearance is normal and does not indicate a faulty switch. If not overloaded or damaged, mercury switches will give long, satisfactory service with no maintenance required. To determine the cause of faulty switching, refer to the contact control component service section.

2. ELECTR-O-VANE CONTROL UNIT

a. **RELAY.** Relay contacts are rated conservatively and should give long service with little maintenance. However, periodically remove black plastic relay cover and inspect contacts for dirt or pitting. If contacts are dirty, clean and polish them with rough unglazed paper. If there is evidence of pitting, dress contacts with burnishing tool, Honeywell part number 362984.

1. GENERAL

A simplified Continuous Balance Potentiometer, consisting of a measuring circuit, amplifier, balancing motor, and indicator is represented by the block diagram shown in Figure 1.

2. INPUT SIGNAL

A primary element detects the condition of the measured variable and supplies the instrument with an input signal (E_{in}) which is proportional to the process condition.

3. FEEDBACK

The feedback voltage E_{fb} of the measuring circuit is a portion of the millivoltage drop across the span network as selected by the slidewire contactor assembly.

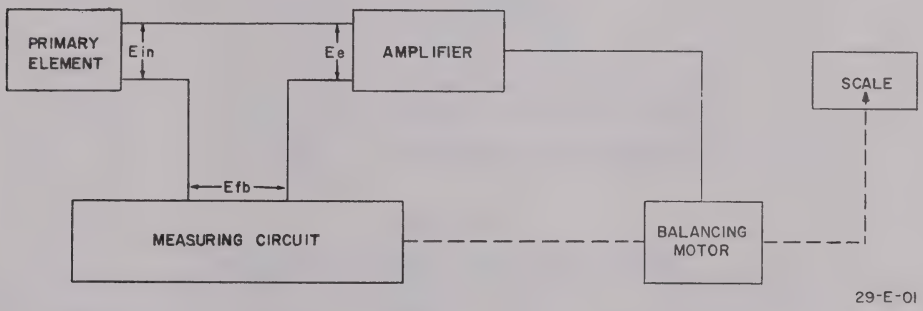


Figure 1. Simplified Continuous Balance Potentiometer.

4. BALANCE

The amplifier circuit compares the feedback signal (E_{fb}) with the input signal (E_{in}), the difference between the two voltages is called the error signal voltage (E_e). The error signal, which is usually in the order of a few microvolts (dc), is amplified to sufficient magnitude to drive the balancing motor. The balancing motor responds to the error signal by mechanically repositioning the slidewire contactor to change the feedback voltage until the error signal is reduced to zero and simultaneously repositions the indicator. At balance, E_{in} and E_{fb} are equal and E_e is zero. If E_{in} is greater than E_{fb}, the indicator will be driven upscale; if E_{fb} is greater than E_{in} the indicator will be driven downscale.

5. DAMPING

Any self balancing system is inherently oscillatory because the inertia of the moving parts prevents the system from stopping exactly when the balance point is reached. To obtain a satisfactory balance-action it is necessary to introduce a feedback loop which, in effect, anticipates the final balance point and causes the system to decelerate before the balance point is reached. The system inertia then causes a rapid drift into the balance position. The feedback is accomplished through the use of an R-C circuit.

RESISTOR BURNOUT THEORY

GENERAL

The burnout signal, a small offset signal, is developed within the measuring circuit across a resistor connected between the measuring bridge and the amplifier. This signal passes a small current through the input source circuitry. Open-circuiting of the source, such as caused by a break in a thermocouple or its extension wires, interrupts the burnout current. This permit the burnout signal to drive the servo system, and thus the pen (or equivalent) to its limit of travel. The direction of the drive is upscale or downscale, as specified.

Because the burnout signal is superimposed on the input signal, it produces an offset which can be eliminated by readjusting zero.

UPSCALE BURNOUT

The value of resistor R_{FUS} used for upscale burnout is a function of span (see table 1). The values selected are chosen to provide maximum drive speed during burnout with minimum zero offset. The magnitude of the offset may be calculated by:

$$\% \text{ FS Offset} = \frac{0.125\ R_S}{(V_{SPAN})\ (R_{FUS})}$$

where:

R_S = Source resistance in ohms
V_{SPAN} = Instrument span in millivolts
R_{FUS} = Value of burnout resistor in megohms

TABLE 1

UPSCALE BURNOUT RESISTOR VALUES

SPAN (MV)	R_{FUS} (Megohms)	PART NO. *	DESCRIPTION
2.5 to 9.999	56.0	210-566	10% 1/2 watt fixed composition
10.0 to 39.999	15.0	210-156	
40.0 to 120.0	4.7	210-475	

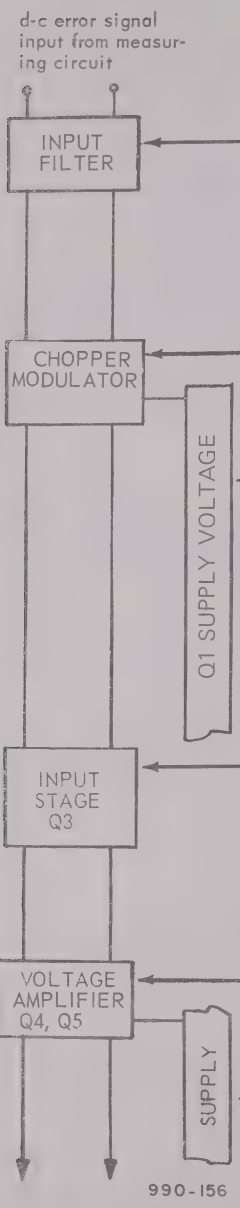
*commercially available

DOWNSCALE BURNOUT

The value of the resistor R_{FDS} used for downscale burnout is a function of resistor R_1 and the voltage span of the measuring circuit. Values are chosen (Table 2) to provide maximum drive speed. Zero offset can be determined by:

FURTHER DEPTH

A schematic of the amplifier board circuit is included in the DRAWINGS section of this manual. The following block schematic represents the same circuit.



Three-section RC filter (R_9, R_{10}, R_{11}, R_{12}, C_4, C_5, C_6) has resistor (R_{11}) which brings to output mode of filter an a-c current nearly equal in amplitude, but opposite in phase to current reaching that point through the filter itself. This gives an attenuation greater than 60 db at 60 Hz. Filter acts on a-c voltages in series with input signal and on a-c voltages in series with suppression portion of circuit feedback voltage. R_{14} is an isolating resistor.

Insulated Gate Field Effect Transistor (I.G.F.E.T.) chopper changes from a very high resistance (drain to source) to a few hundred ohms on opposite half-cycles. This action has the effect of presenting the a-c amplifier alternately with the input voltage and the feedback voltage.

Chopper drive circuit shapes and clips secondary voltage of power transformer (T_1) to produce negative-going square wave. Amplifier Q_1 is preceded by an RC low-pass filter which removes high-frequency components (hash) from that secondary voltage. Capacitor (C_1) couples square wave to I.G.F.E.T. gage causing wave to have zero average value, assuring low "on" resistance, and repeatable performance (same "pinch-off" voltage).

High impedance, N-channel junction gate Field Effect Transistor (Q_3) which has 1K source resistor (R_{44}) for gain and biasing stabilization, 10 megohm gate leak resistor (R_{16}), and 10K (1/4 watt) board resistor (R_{17}).

Direct coupled PNP complementary pair (Q_4, Q_5) with d-c and a-c feedback, to eliminate effects on signal by final power supply zener diode (VR_1) as well as any "motor boating" due to marginal power supply isolation.

Power supply for voltage amplifiers is half wave rectifier (CR_3), 100 uf capacitor (C_{13}) and two stages of resistance zener diode isolation (R_{38} with VR_2; R_{21} with VR_1).

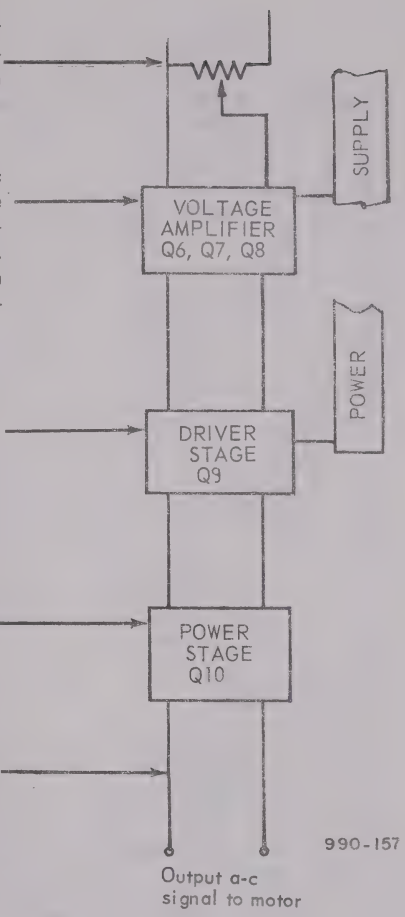
Gain adjustment is obtained by picking signal from collector resistor (R_{24}) of Q_5. Diode "pedestal" CR_4 prevents polar coupling capacitor (C_{10}) from sustaining a reverse voltage for low gain settings.

NPN block of three stages direct coupled with both a-c and d-c feedback. (These silicon transistors have quiescent collector-base voltages of essentially zero, eliminating need for "pedestal" between collectors of preceding and bases of following transistors). The 100 ohms (R_{27}) in emitter of Q_6 has virtually no effect on bias point and simply serves as part of network providing feedback signal from motor winding.

Quiescent current from this low power PNP silicon transistor (Q_9) is fed to base of power stage (Q_{10}). It is determined by divider R_{40} and R_{33} emitter resistor (R_{42}), and to a small extent, the h_{FE} of the transistor. Gain is primarily determined by R_{42}.

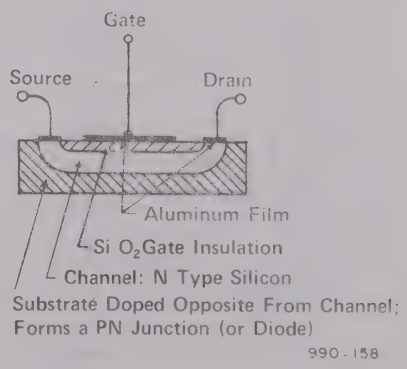
Converts the small power signal of the driver to the power level required by the motor. Dither, required in reducing deadband to overcome static friction in motor and mechanical system, is determined by output stage quiescent current.

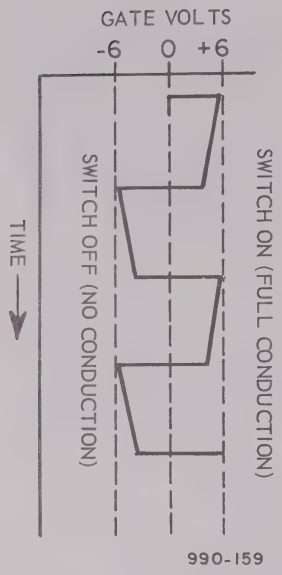
Effective output impedance of amplifier is lowered by means of feedback to emitter of Q_6 through C_{15}, and R_{36} or (by changing gain jumper) R_{34} .



ABOUT THE I.G.F.E.T. "CHOPPER" (Depletion type)

QUICK THEORY — The electrostatic field set up in the channel by the gate bias affects the mobility of the carriers. Enough reverse bias will immobilize all carriers, stopping all current flow in the channel. This is the cutoff (or pinch off) condition. If no bias is applied to the gate, there is no restriction other than the resistivity of the channel to current flow.



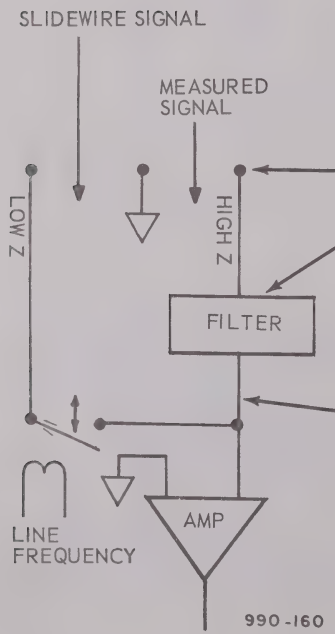


GATE SIGNAL — With a properly sized gate signal, the IGFET can be made to act like a switch. In the chopper circuit of this amplifier board:

−6 volts = full bias (switch OFF)

+6 volts = zero bias (switch ON).

The gate signal is a line frequency (50 or 60 Hertz) square wave.



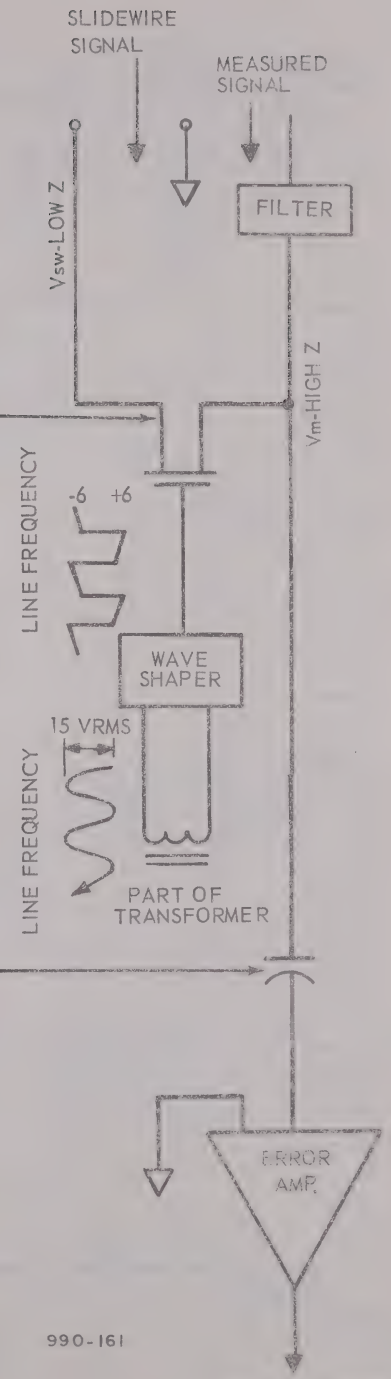
MECHANICAL ANALOG of IGFET chopper

Measured signal and slidewire signals "enter" separately.

The measured signal is applied across a higher impedance (200K) than the slidewire signal (5K).

A switch is vibrated open and closed at line frequency. When switch is open (OFF), measured signal is applied direct to amplifier. When switch is closed (ON), slidewire signal path has the lower impedance (compared to the measured signal path), so the slidewire signal passes to the amplifier and the measured signal is "shunted out".

IN OTHER WORDS the switch can be thought of as sampling at line frequency, looking at the input and then at the slidewire.



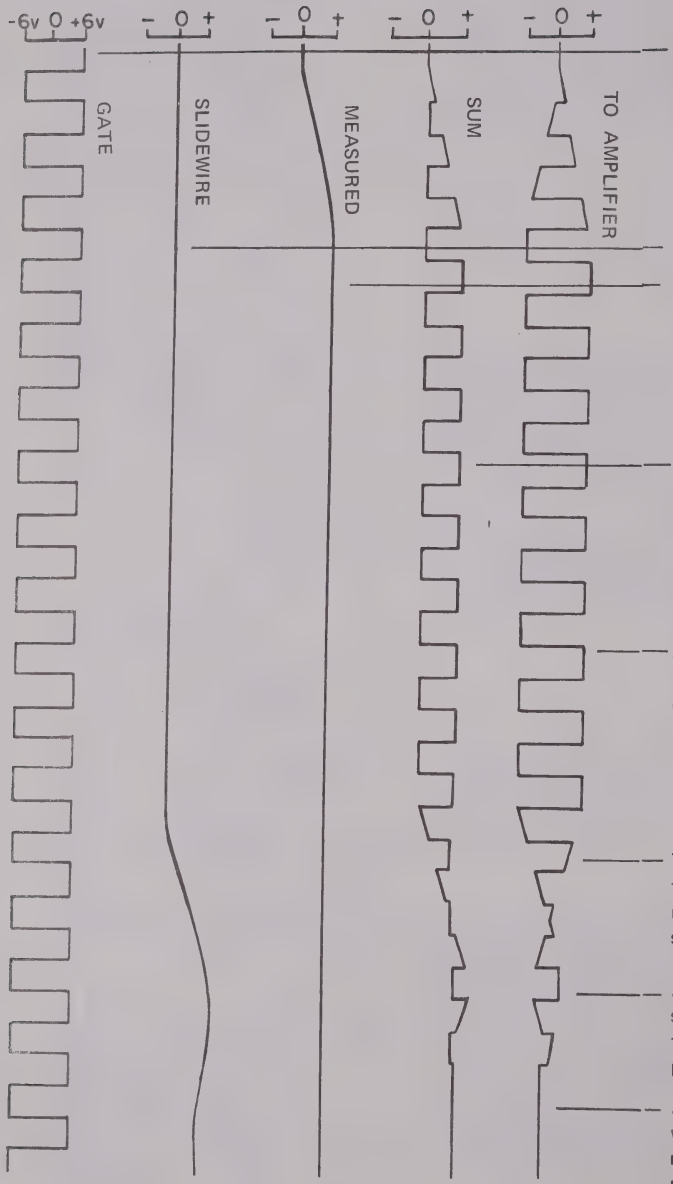
USING AN IGFET:

The IGFET is being driven from saturation to cut off by the square wave gate signal alternating between +6 volts and —6 volts at the line frequency reference rate. It is alternating between high and low impedance over a great enough range to appear to this circuit as a mechanical ON-OFF switch.

As before, the two signals are similar in voltage level, but are applied at differing impedance levels. As a result, the voltage appearing at the lower impedance level can dominate, or "swamp" the other when they are applied to the same point for a brief period of time.

COUPLING CAPACITOR

With the IGFET OFF, the measured signal is seen by the amplifier. With the IGFET ON, the slidewire signal is seen by the amplifier. Beyond the coupling capacitor this signal becomes truely modulated a-c.



GATE SIGNAL — at +6 v. (ON) circuit "sees" slidewire signal, at —6 v. (OFF) circuit "sees" measured signal.

SLIDEWIRE SIGNAL AND MEASURED SIGNAL — are displayed in this example as 0, +, — only to their value relative to each other.

SUMMED SIGNAL — A "gated look" first at slidewire signal then at measured signal. When the two are out of balance as shown here it becomes pulsating d-c.

SIGNAL TO ERROR AMPLIFIER — to the coupling capacitor. Beyond that point it is true modulated a-c.

This signal, amplfied and sent to the servo motor, causes the motor to change the slidewire signal . . .

. . . with a little overshoot shown here (motor would then reverse to correct the position of slidewire). . .

. . . until measured and slidewire signals are balanced and no error signal occurs: hence no drive signal goes to motor.

Obviously in this example, time lags gate signals, etc. are not in proportion.

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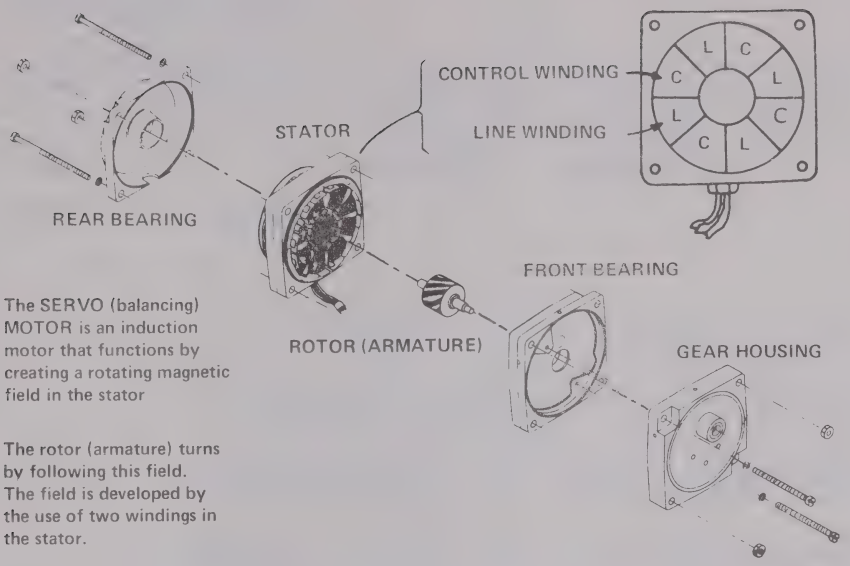


The SERVO (balancing) MOTOR is an induction motor that functions by creating a rotating magnetic field in the stator

The rotor (armature) turns by following this field. The field is developed by the use of two windings in the stator.

5

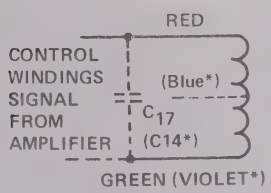
positive signal
(lags 90° from line due to line phase capacitor C_{16} (C13*) of amplifier board)

or

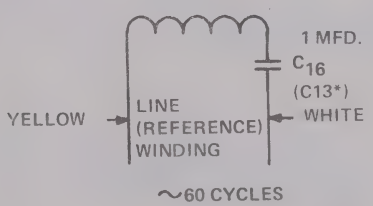
negative signal
(leads 90° from line due to line phase capacitor C_{16} (C13*) of amplifier board)

or

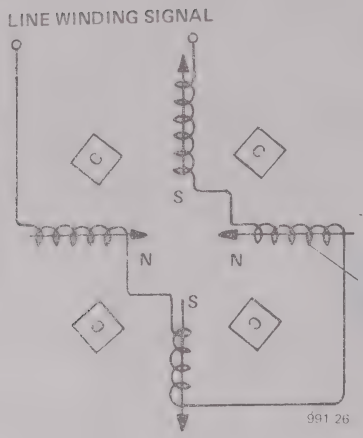
dither signal at balance



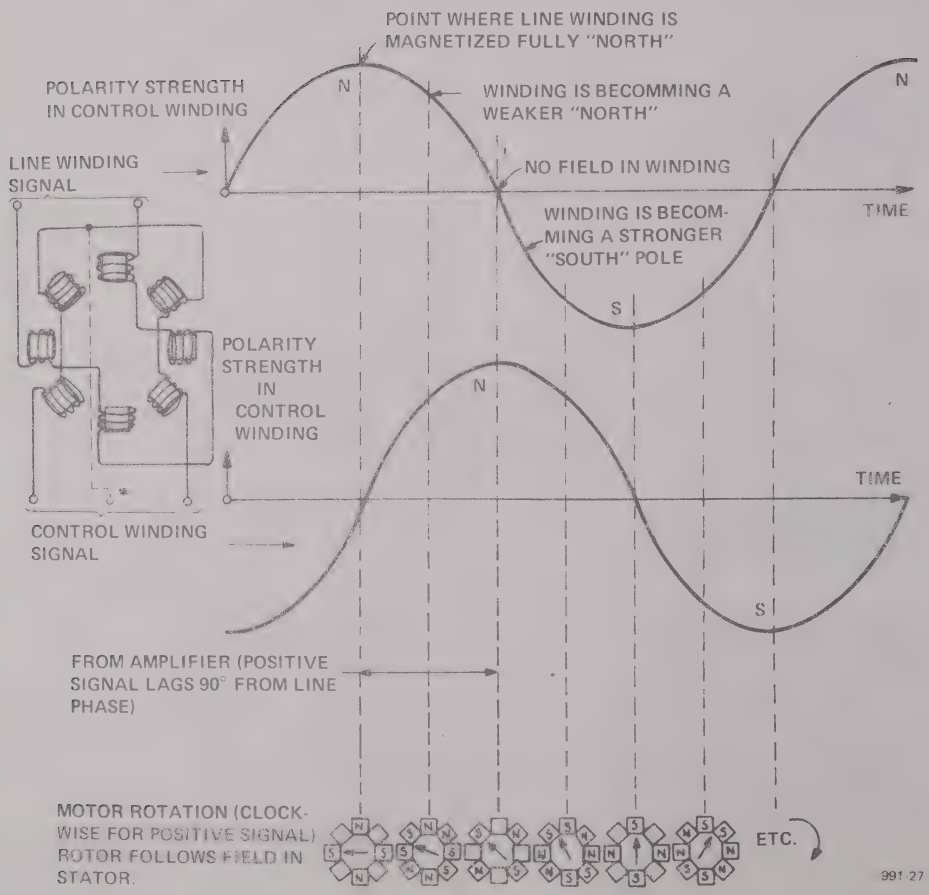
Signal in control winding appears as ∩∩∩∩∩ due to tank circuit formed by winding and C_{17} (C14*) of amplifier board.



*on push-pull version, using 5 wire motor



Windings are arranged so that opposing coils of the same winding have the same polarity, but adjacent coils of the same winding are of opposite polarity.



*on push-pull versions, using 5 wire motor

CONTACT CONTROL THEORY

1. MERCURY SWITCH ASSEMBLY

Each deck of the assembly can have either one or two mercury switches. All switches are the single-pole, single-throw type. They are mounted to provide the specified contact action, with contacts either normally open or normally closed. Two switches can be mounted on one deck and wired as a single-pole, double-throw switch.

2. DIFFERENTIAL MECHANISM

a. SINGLE INDEX

(1) The differential mechanism is a gear assembly used to select the point at which a mercury switch (or switches) will be actuated by the changing process variable. When the set point index is positioned, the gears simultaneously position a slotted lever with respect to the sector gear, which is driven by a gear on the shaft of the pen drive gear. A drive tooth mounted on the sector gear engages the slot in the slotted lever as the process variable passes through the set point, in either direction, and moves the lever through an arc.

(2) In a single switch mechanism, (illustrated in the contact control description section) a single linkage lever is secured to the linkage lever shaft by a setscrew. The linkage lever is not adjustable. When the linkage lever moves, a connecting link attached to the mercury switch assembly actuates the spring-loaded switch assembly.

(3) Operation of the differential mechanism of the dual switch assembly (illustrated in the contact control description section) is similar to that of the single mechanism. The significant difference is in the arrangement of the linkage lever. The dual linkage lever assembly is actually two levers, each of which actuates one switch assembly through a separate connecting link. When the process variable passes through the set point on a dual mechanism controller, one lever will actuate its associated switch several scale divisions before the other. The two levers can be adjusted with respect to each other and to the set point index, by means of screws, over a total range of approximately 15% of full scale.

(4) Each mercury switch can be adjusted over a restricted range by loosening the screw in the switch mounting clip and rotating the clip, which has an elongated mounting slot. The mounting screw can be inserted into either of two threaded holes, providing additional adjustment range.

b. DUAL INDEX

Dual index contact control incorporates two differential mechanisms, each independently adjustable in conjunction with a respective set point index. Each differential mechanism is linked to a mercury switch assembly that has two SPST switches wired to operate as a SPDT switch. Each independent contact control mechanism operates in the manner described above for the single switch mechanism.

INSTRUMENT SERVICE

1. GENERAL

This section includes procedures for the isolation of malfunctions by performance symptoms, for the isolation of defective components by voltage and resistance checks, and for the disassembly, reassembly, and adjustment of the instrument to correct for a malfunction. Wiring diagrams and check point location diagrams are included in this section.

NOTE: If the instrument is a non-controlling strip chart recorder, refer to the input selector switch service section; if it is a controlling strip chart recorder, refer to the selector switches and timing mechanism service section. Perform the alignment checks and adjustments given there before following any of the troubleshooting procedures contained in this section.

2. TROUBLESHOOTING PROCEDURE

The servicing procedures are intended to permit maximum analysis with minimum equipment and minimum downtime. The following approach is used:

a. Identify the malfunction in terms of instrument performance and locate the trouble under Symptomatic Analysis.

b. Follow the procedures to isolate the faulty component.

c. Replace a faulty component whenever possible.

d. Separate sections include troubleshooting procedures for placing some defective components back in operation.

3. SYMPTOMATIC ANALYSIS

a. No Drive

(1). Make sure the instrument and its various assemblies are being supplied with power. With the power switch in the ON position check for 120 Vac at the following locations:

(a) Between the a-c line hot and neutral terminals on the power terminal block in the back of the instrument case.

(b) At the power terminals on the chassis terminal block.

(c) Between the white and black leads on the quick-connect amplifier plug.

(2) Check that the cable drive system is free to move. Turn off instrument power and rotate the drive gear to position the indicator at 50% full scale.

(3) Turn the instrument power on. If the indicator does not move the condition of "No Drive" has been verified. If the indicator moves to either end of scale refer to the symptom "Drives Against Stop."

(4) Remove the primary element connections and use a multimeter to check for continuity across the input terminals; observe proper polarity. The resistance should be less than 100,000 ohms. During this test the multimeter is applying a voltage to the instrument; if this causes the balancing motor to drive, the trouble is external to the instrument. Check the primary element and its wiring.

(5) If the motor does not drive in step (4), connect the multimeter across the input terminals of the amplifier. If this causes the motor to drive the trouble is probably in the measuring circuit (this includes the slidewire); check these components.

(6) If the motor fails to drive in step (5) use a second multimeter to check the voltage across the control winding of the balancing motor. The voltage across the control winding terminals on the chassis terminal block (see schematic) may be analyzed as follows:

(a) If the voltage is in the order of 300 to 400 Vac, the control winding of the balancing motor is probably open.

(b) If the voltage is approximately line voltage, the line winding of the balancing motor is probably open.

(c) If the voltage is less than 100 Vac, the amplifier may be defective; if the voltage is almost zero, however, the control winding of the balancing motor is probably shorted.

NOTE: If a second multimeter is not available a flashlight dry cell can be used to provide a drive signal.

(7) Replace the suspected component if a spare is available.

b. DRIVES AGAINST A STOP

(1) Disconnect the primary element and connect a multimeter across the measuring circuit input terminals. If the instrument does not respond reverse the multimeter connections.

(2) If the instrument responds in step 1:

(a) Check the primary element and its associated circuitry.

(b) Check slidewire and contactors for dirt, misalignment, or excessive wear.

(c) Check continuity of slidewire at measuring circuit connections.

(d) Check output of Constant Voltage or AC-DC unit.

(e) Check measuring circuit resistances.

(f) Check amplifier by substitution.

c. Jumpy

(1) Shake the various internal input wires, while observing instrument performance, to see if an intermittent open circuit can be found. Also check the primary element and associated external wiring for an open circuit. Check for transient stray signals which may exceed the instrument specifications.

(2) Check all connections to the amplifier and power assembly circuits, the Measuring Circuit Unit, the Constant Voltage or AC-DC Voltage Unit, the chassis terminal block and the slidewire.

(3) Check the slidewire contactors for excessive wear, poor tension or misalignment; check the slidewire for dirt or wear.

d. Instrument Is Insensitive

(1) Check amplifier sensitivity setting.

(2) Check shield connections and reference wiring (if applicable).

(3) Verify that stray level does not exceed instrument specifications.

(4) Make sure gearing and cabling of balance system are free to move.

(5) Check amplifier (by substitution if a spare is available).

e. Calibration Has Shifted Radically

(1) Make sure no one has tampered with zero or span adjustments.

(2) Check output of Constant Voltage Unit or AC-DC Voltage Unit.

(3) Check stray level.

(4) Check Measuring Circuit Unit (by substitution, if a spare is available).

(5) Check that amplifier fail-safe feature has not been removed (or added following calibration).

(6) Check that drive cable is securely attached to indicator assembly.

(7) Check resistance of slidewire.

DRIVE CABLE — SERVICE

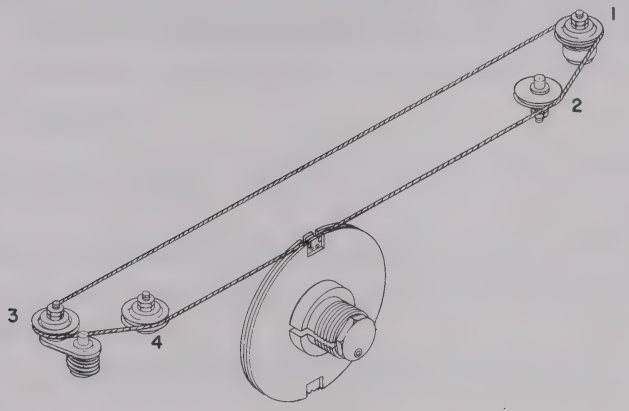
1. REMOVAL

a. Swing chassis out of case and remove gear housing cover plate from left-hand side casting.

b. Turn balancing motor pinion clockwise until drive gear hits limit stop.

c. Loosen, but do not remove, cable clamp screws.

NOTE: If the instrument has auxiliary switches, loosen knurled nut which clamps actuating cams, turn cam until one of the holes is in line with the screws in the drive cable clamp. Cable clamp can then be loosened without removing cam.



36-E-16-18

d. Loosen carriage clamp screws and free cable.

e. Press cable tension pulley (3) inward and lift cable off both this pulley and guide pulley (4) adjacent to it.

f. Remove end of drive cable from outer slot in cable clamp.

g. Pass cable around pulleys (1 and 2) and remove other end of cable from cable clamp.

h. Remove cable carefully; avoid kinking.

2. INSTALLATION

a. Turn balancing motor pinion counterclockwise until drive gear hits limit stop.

b. Place one end of drive cable in inner slot of cable clamp so that cable extends through slot toward left-hand side casting. Pass cable around guide pulleys (1 and 2) and under carriage clamps; do not clamp cable in place.

c. Pass cable around guide pulley (4) but not around cable tension pulley (3).

d. Insert free end of cable in outer slot of cable clamp.

e. Press cable tension pulley in and slip cable into position on that pulley.

f. Tighten screws on cable clamp.

g. Tighten clamps on indicator carriage. Check carriage alignment and instrument calibration before placing instrument back in service.

ALIGNMENT SERVICE

1. ALIGNMENT CHECK

a. Check alignment of indication system and adjust (if necessary) at the side of the chart which has round holes. In the following steps it is assumed that round holes are on right-hand side of chart and elongated holes (for humidity compensation) are on the left.

b. With chart installed, manually move indicator carriage to right-hand limit (turn drive gear or equivalent). Indicating pointer should line up with extreme right-hand scale graduation, or with another appropriate chart graduation if instrument is equipped with a right-hand event marker pen.

c. On single record instruments, record should coincide with appropriate chart graduation. On multirecord instruments, vertical line of + symbol should print on appropriate chart graduation.

d. On two pen instruments repeat alignment check for red pen.

2. CARRIAGE ALIGNMENT

a. Loosen knurled nut on right-hand side of slidewire housing and swing housing open.

b. Loosen carriage clamps and re-position indicator carriage as required.

c. Be sure cable is in cable clamp slot, tighten clamp, and close slidewire housing.

d. On two pen instruments repeat carriage alignment, if necessary, for red pen.

3. SCALE ALIGNMENT

a. Move indicator carriage to extreme right-hand limit.

b. Loosen screws which secure scale and shift scale until appropriate graduation lines up with pointer; tighten screws.

c. Move indicator carriage to extreme left-hand limit. Appropriate scale graduation should line up with pointer within 0.01 inch. Record may, or may not, coincide with chart graduation depending on ambient humidity conditions.

d. On two pen instrument align scale with purple pointer, then align red pointer with scale, (loosen two screws, shift red pointer, retighten screws).

CALIBRATION CONNECTIONS — SERVICE

1. PRELIMINARY PROCEDURES

a. SINGLE-POINT INSTRUMENTS

(1) Without checking terminals: Disconnect leads of primary element from plus (+) and minus (-) terminals on measuring circuit panel.

(2) With checking terminals: Disconnect shorting bar between instrument plus terminal (INSTR) and thermocouple plus terminal (TC) on instrument door.

b. MULTIPOINT INSTRUMENTS

(1) On all multipoint instruments, including Universal type, remove connections between measuring circuit panel and multipoint input terminal panel. Calibration is same as for single-point instrument with connections made directly to measuring circuit panel.

(2) On two pen instruments the entire calibration procedure must be repeated for each measuring circuit.

2. TEST CONNECTIONS

a. For millivolt, Radiamatic* unit, and other uncompensated except tachometer actuations, connect copper leads from a low impedance precision voltage source (such as a Biddle 72-310) to the instrument input terminals (figure 1).

NOTE: Methods of calibration differ depending on whether instrument has burnout or not and what type. Refer to section on calibration procedures for further information.

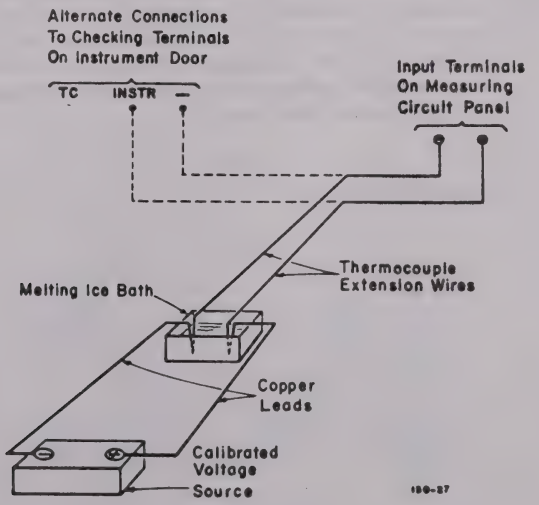


Figure 1. Test Connections

* *Honeywell Trademark*

631 0017 150

b. For thermocouple (compensated) actuations you can use either of two methods to check calibration. While highest accuracy will be obtained by using the calibrated voltage source in conjunction with an ice bath, you can get reasonable accuracy without the ice bath.

(1) Ice Bath Method

(a) Connect copper leads from voltage source to a pair of thermocouple extension wires.

(b) Connect extension wires to instrument input terminals. Observe proper polarity.

(c) Immerse each junction of a copper lead and an extension wire in a melting ice bath; keep the junctions electrically insulated from each other and from the bath. Allow the junctions to stabilize at 0°C (32°F). Bath should be stirred for highest accuracy.

(d) Determine input voltages directly from a table of temperature-emf equivalents (reference 0°C or 32°F) for the specific type of thermocouple.

(2) Without Ice Bath

(a) Connect copper leads between precision voltage source and instrument input terminals. Observe proper polarity.

(b) Use a mercury thermometer to determine temperature at reference junction in instrument.

(c) Determine input voltages by algebraic addition of emf equivalents for the reference junction temperature and for the required scale readings.

NOTE: The following text assumes the instrument to be calibrated is a single-pen circular chart recorder. For strip chart recorders, substitute indicator for pen; for circular scale indicators, substitute scale for pen.

1. AMPLIFIER

a. GAIN (Sensitivity)

The gain adjustment changes the sensitivity to input signals greater than 0.1% of full scale. The adjustment is located on the amplifier. Turning the screw clockwise increases sensitivity, counterclockwise decreases sensitivity. The optimum setting should give minimum or no overshoot (0.5%, 0.03", or less) for 90% full scale step change.

b. ZERO BALANCE ADJUSTMENT

The balance adjustment is factory - set and should rarely need to be used. It controls the level of compensating current to cancel the effects of residual microvoltages caused by chopper (or circuit) emfs. In effect, this zeros the amplifier for correct measurement of the input signal. It may need adjustment on narrow-span instruments. Adjust as follows:

NOTE: Do not use this adjustment to compensate for small errors caused by factors such as stray.

(1) Connect all three leads of the amplifier together under the X terminal.

(2) Remove amplifier cover. Observe servo motor. Adjust balance pot until there is no movement of the motor.

(3) Replace amplifier cover. Reconnect leads.

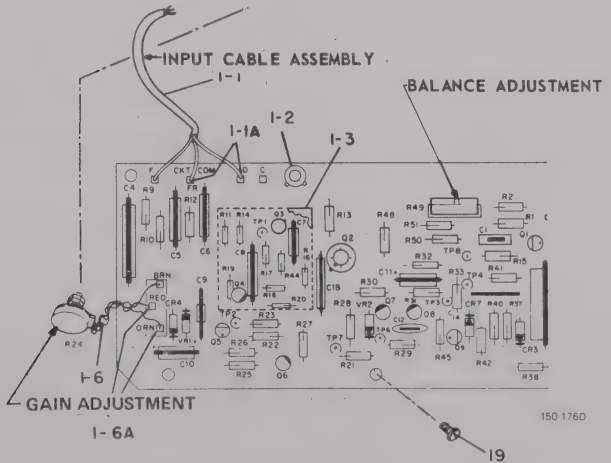


Figure 1. Amplifier Gain and Balance Adjustments

2. ZERO (Instruments Without Burnout)

NOTE: If instrument has resistor burnout, see paragraph 4.

a. **GENERAL** Set voltage source to emf equivalent for major graduation nearest 10% full scale. If instrument does not balance to selected point adjust zero using method appropriate for instrument design.

b. **ELECTRICAL ZERO ADJUSTMENT.** If the measuring circuit design includes an electrical zero adjustor:

(1) Loosen retaining screws and remove measuring circuit cover.

(2) If instrument reading is too high or too low, turn adjustor clockwise or counterclockwise respectively.

(3) Replace cover and tighten screws.

c. **MECHANICAL ZERO ADJUSTMENT**

(1) Instruments with straight slidewire:

(a) Remove two screws which connect upper and lower sections of slidewire compartment.

(b) Loosen knurled knob on slidewire housing and raise upper section to gain access to slidewire mounting screws and zero adjustor.

(c) Loosen four slidewire mounting screws.

(d) If instrument reading is too high or too low, turn adjustor to move slidewire to the left or to the right respectively.

(e) Tighten slidewire mounting screws and reassembly slidewire compartment.

(2) Instruments with helical slidewire:

(a) Remove cover from slidewire assembly.

(b) Loosen clamping screw on contact guide arm.

(c) Turn adjusting screw to move contact guide arm clockwise to correct for a high reading; counterclockwise to correct for a low reading.

(d) Tighten clamping screw and replace slidewire cover.

3. SPAN (Instruments Without Burnout)

NOTE: If instrument has resistor burnout see paragraph 4.

a. Set voltage source to emf equivalent for major graduation nearest 90% full scale.

b. If intrument does not balance at selected point, use adjustment on measuring circuit panel to adjust instrument span.

(1) Loosen locking screw and move slider along resistance wire.

(2) Tighten slider locking screw and check instrument reading.

(3) Repeat steps (1) and (2) until instrument reading is appropriate for applied input voltage. Do not retighten locking screw after correct instrument reading is obtained.

(4) Check calibration at several other major graduations.

(5) If necessary, repeat zero and span adjustments until calibration is satisfactory.

4. ZERO AND SPAN (Instruments With Burnout)

a. GENERAL

(1) In ElectroniK 15 potentiometers, the resistor burnout signal causes the pen to drive to one end of the scale should the input circuit open. The burnout signal is superimposed on the input signal and causes an offset from zero. This can be compensated for by readjusting zero.

(2) The magnitude of the zero offset caused by the burnout signal current flowing through the external circuit (source) resistance depends on two factors: (1) instrument span, and (2) external circuit resistance. The narrower the span and/or the higher the external resistance, the greater the zero offset.

(3) In calibrating potentiometers having burnout, a difference in the resistance between the calibration equipment and the actual input source (e.g., thermocouple and extension wires) can introduce a zero offset error proportional to the magnitude of the difference in resistance. Portable potentiometers normally used for such calibration do not have a fixed output resistance. The resistance at the output terminals varies dependent upon the millivolt setting. Such differences within the instrument range create differences in zero offset at the calibration points due to burnout. The difference in zero offset may be significant with narrow spans or with portable potentiometers having high internal resistance.

b. INSTRUMENTS WITH RESISTOR BURNOUT

(1) Three alternative methods are given below. Available calibration equipment and circumstances will dictate which method can be used on a particular installation.

(2) Method No. 1

(a) This method requires modifying the measuring circuit unt so that the burnout circuit may be opened during calibration. The burnout resistor is soldered across two terminals on the back of the measuring circuit board. To modify, remove this resistor from the back of the board, solder spade lugs on the resistor leads, and mount on the front of the board to the same two terminals. Burnout resistor can be left here for convenience when required to check calibration again.

(b) Adjust amplifier gain for optimum sensitivity (see paragraph 1).

(c) Disconnect one end of burnout resistor on measuring circuit board to remove burnout.

(d) Check and, if necessary, adjust zero and span as described in paragraphs 3 and 4 for instruments without burnout.

(e) Apply on-scale input potential.

(f) Reconnect end of burnout resistor on measuring circuit board.

(g) Add series resistance approximately equal to the resistance of the external circuit normally connected to the instrument (sensing unit and connecting wires).

(h) Note amount of zero shift and eliminate by readjusting zero.

(3) Method No. 2

(a) Using this method, the instrument can be calibrated with the burnout resistor in the circuit. Accurate calibration can be obtained regardless of the variations in resistance of the potentiometer used for calibration.

(b) Adjust amplifier gain for optimum sensitivity (see paragraph 1).

(c) Make test set up shown in figure 2. If a millivolt input source such as a Biddle 72-542 run-up box is used, be certain that it is a type having fixed resistance (100 ohms or less) at the output terminals.

(d) Temporarily connect calibration potentiometer and adjust source for desired MV output to the instrument. Disconnect before taking reading.

(e) Check and, if necessary, adjust zero and span as described in paragraph 3 and 4.

(f) Apply on-scale input potential.

(g) Add series resistance approximately equal to the resistance of the external circuit normally connected to the instrument (sensing unit and connecting wires).

(h) Note amount of zero shift and eliminate by readjusting zero.

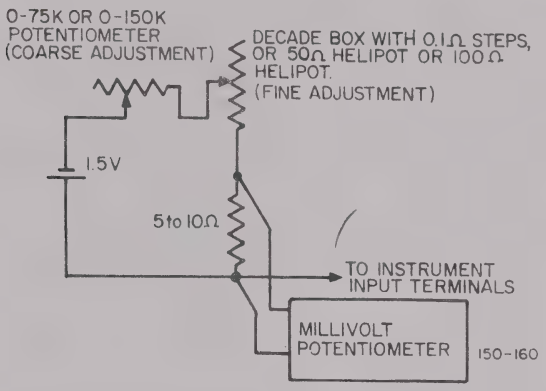


Figure 2. Typical Calibration Setup for Instruments Having Resistor Burnout (Method No. 2)

(4) Method No. 3

(a) This method partially compensates for variations in zero shift within the instrument range caused by differences in the internal resistance of the calibrating potentiometer with changes in dial setting. With wider instrument spans or lower resistance of the calibrating potentiometer, inaccuracies caused by zero offset will be negligible.

(b) Adjust amplifier gain for optimum sensitivity (see paragraph 1).

(c) Set the calibrating potentiometer at a MV value equivalent to the approximate midpoint of the instrument range. Disconnect the battery and measure the resistance at the output terminals.

(d) Reconnect the battery. Check and adjust zero and span as described in paragraphs 3 and 4 for instruments without burnout.

(e) Measure the resistance of the external circuit normally connected to the instrument (sensing unit and connecting wires). Find the difference between this resistance and the resistance of the calibrating potentiometer measured in step (c).

(f) Apply an input potential approximately equal to the midpoint of the instrument range. Note reading.

(g) Add series resistance approximately equal to the difference in resistance found in step (e).

(h) Remove series resistance and allow instrument to return to midpoint reading observed in step (f).

(j) Correct for offset observed in step (g) by readjusting zero.

1. If the resistance of the external circuit is higher than that of the calibrating potentiometer, shift zero downscale from the midpoint an amount equal to the offset.

2. If the resistance of the external circuit is lower than that of the calibrating potentiometer, shift zero upscale from the midpoint an amount equal to the offset.

RESISTOR CALCULATIONS — SERVICE

1. RANGE CHANGE

a. GENERAL. The measuring circuit design permits quick and easy changing of the instrument range. The range resistor panel and the reference spool panel can each be removed and replaced by panels for a different range or actuation. A screwdriver is the only tool required for this conversion. Make conversion as follows:

(1) Loosen the screws which retain the panels

(2) Remove panels and install replacements; tighten screws

(3) Check calibration.

b. KITS. Range change kits are available; order from nearest Honeywell branch office. Refer to instrument nameplate and specify:

(1) Instrument model number

(2) Instrument serial number

(3) Present range and actuation

(4) Desired range and actuation

c. ACTUATION If both the actuation and range are being changed, select the appropriate reference junction spool for the new actuation from Table 2.

d. BURNOUT. If the measuring circuit design includes upscale resistor burnout, select new Rfus from tables in section 536.

2. RESISTOR CALCULATIONS

This paragraph describes how the resistor values for the measuring circuit are calculated according to the range, span, and type of input being used. This information is included to supplement the measuring circuit schematic diagram.

a. FORMULAS

$$R_1 = \frac{Ic\ Rni + MVmin - MVc - A\ MVs - E}{Ia}$$

$$Rt = \frac{B\ MVs}{C\text{-}MVs} \quad \text{(See note)}$$

$$R_2 = \frac{Rt\ X\ R\ divider}{R\ divider - R} \quad \text{(See note)}$$

NOTE: For Radiamatic circuits, calculate both Rt and R_2 as given above. Value of divider depends upon the range of adjustment of the calibrating rheostat:

50% to 110% = 3600 ohms
50% to 200% = 2600 ohms

For any other potentiometer actuation, the formula for Rt is the formula for R_2.

$$R_3 = \frac{Ic \times 509.5 + MVc - MVmin - D\ MVs}{Ia}$$

$$R_c = 514.5 - Rni$$

b. NOMENCLATURE

Ia = Current through upper branch of measuring circuit. See Table 1.

A, B, C, D, E, = Constants per Table 1.

Ic = Current through lower branch of measuring circuit. Ic = 6 ma - Ia.

Rni = Resistance of reference junction compensating resistor at 75° F. See Table 2.

MVc = Millivoltage correction from 32° F (or 0° C) to reference of 75° F. See Table 2.

MV min = Millivoltage corresponding to 0% full scale; based on reference junction at 0° C or 32° F.

MVs = Millivolt span (MVmax - MVmin).

Rdivider = 2600 50% - 200
3600 50% - 110

TABLE 1

CONSTANT VALUES

Span (mv)	Ia (ma)	A	B	C	D
0 to 40	4	.021	20.474	76.923	1.0437
40.1 to 63	4	.021	21.154	76.923	1.079
63.1 to 75	4	.021	23.179	76.923	1.1844
75.1 to 100*	5.5	.021	23.179	105.769	1.1844
100.1 to 900**	4	.0201	254.850	961.538	1.0401

* For uncompensated ranges only.
** 250-ohm slidewire required.

TABLE 2

REFERENCE JUNCTION CHARACTERISTICS

Type Couple	Part Number	Wire	Resistance in Ohms at 75° Rrj or Rni	MVc (Ref. at 0°C or 32°F)
J (I/C)	365927-1	Copper	6.787 ± .014	1.2394
J	365927-8	Copper	6.754 ± .014	1.218
K	365927-2	Copper	5.255 ± .011	0.952
Y	365927-3	Copper	6.909 ± .014	1.2585
T	365927-4	Copper	5.359 ± .011	.9441
R	365927-5	Copper	0.796 ± .002	.1357
S	365927-5	Copper	0.796 ± .002	.1366
Uncomp.	365927-6	Manganin	5.000 ± .010	0
N. N. Moly	365927-7	Copper	5.192 ± .010	.920
E (Chromel-constantan)	365927-18	Copper	7.972 ± .014	1.424

TABLE 3

SPAN ADJUSTOR VALUES

Span (mv)*	Total Resistance (ohms)	Part No.
0 to 40	.87	363024-1
40.1 to 63	2.2	363024-4
63.1 to 100	6.2	363024-3

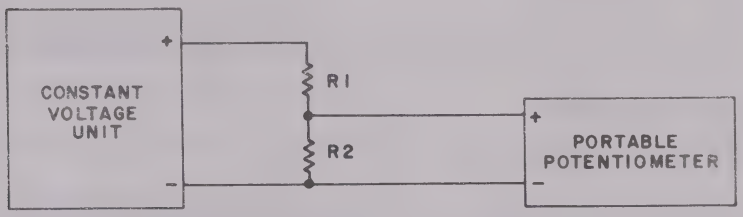
*For Radiamatic circuit use emf equivalent of temperature X maximum range of adjustment of calibration rheostat.

REGULATED POWER SUPPLY MEASURING SYSTEM — SERVICE

OUTPUT VOLTAGE CHECK

1. Disconnect output of the power supply from the measuring circuit unit.

2. Constant Voltage Unit (potentiometers). If a precision voltage source is used (such as a Biddle 72-310) it will be necessary to construct a voltage divider network across the output terminals of the constant voltage unit as shown in Figure 1. A decade box may be used if available; otherwise use two part number 30076098-999-(resistance value) manganin resistors or their equivalent (±0.05% tolerance). The sum of the two resistors must equal the recommended load resistance for the constant voltage unit. The value of resistor R2 must be small enough to permit accurate measurement; select the values for R1 and R2 from Figure 1.



Constant Voltage Unit	Frequency (cps)]	Current (ma)	Output (volts)	Load (ohms)	Dummy Load (ohms)		Voltage Across R2 (MV)
					R1	R2	
30365389-501	50-60	6	1.029	171.5	161.5	10	60
30365389-502	50-60	8	1.029	128.63	121.1	7.5	60
30365389-503	50-60	6	4.200	700.	690	10	60
30365389-504	25	6	1.029	171.5	161.5	10	60
30365389-505	25	8	1.029	128.63	121.1	7.5	60
30365389-506	25	6	4.200	700.	690	10	60
30365389-507	50-60	6	5.0637	843.95	833.95	10	60

150-190

Figure 1. Constant Voltage Unit, output voltage check.

3. AC-DC Unit (resistance bridges). Connect a 1K ±5% dummy load resistor and a 20,000-ohm-per-volt voltmeter in parallel across the output terminals. The measured voltage should be no lower than 1.3 to 1.7 Vdc.

634-0007-150

4. If the correct voltage is not obtained, using one of the above methods, replace the unit.

NOTE: Voltage and resistance checks are given below. Field repair of these units is not recommended. If a unit is thought to be defective, return it to your nearest Honeywell Branch office for repair - exchange on another unit.

INSTALLATION OF REPLACEMENT UNIT

1. Shut off instrument power.

2. Note or tag the five external connections, i.e., line (H and N), ground (G), and output (+ and -).

3. Break external connections.

4. Remove the two mounting screws and remove the unit from its mounting surface.

5. Install replacement unit by reversing preceding steps (use enclosed measuring circuit wiring diagram to verify noted connections).

VOLTAGE CHECKS

1. Connect the unit as described above.

2. Check voltages, using a multimeter (20,000 ohms per volt), from the primary of the transformer up to and including the second stage zener diode. Voltages should be in accordance with Table 1.

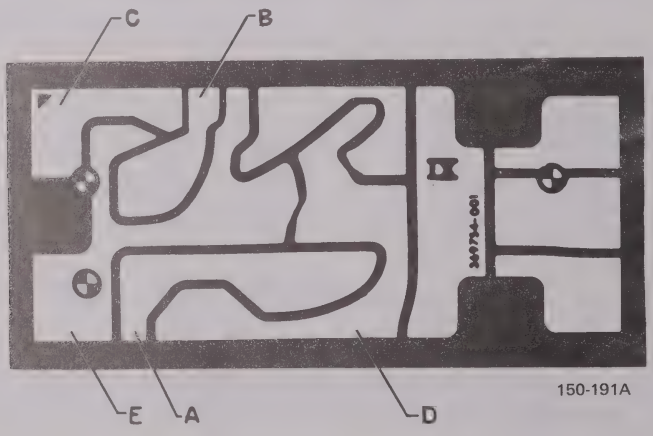


Figure 2. Printed Wiring Board Diagram, Showing Test Point Locations.

REGULATED POWER SUPPLY MEASURING SYSTEM

SERVICE

TABLE 1

AC-DC UNIT	C.V.U.	Replacement	DC voltage bt. pts.				Component Values					
			A-D	A-E	B-E	C-E	R1 (ohms)	R2 (ohms)	R3 (ohms)	R4 (ohms)	C1 (mfd)	RM
	30365389-1	30365389-501	55	16	6.65	1.029	-	29.4K	787	2100	100	
	-2	-502	55	16	6.65	1.029	3400	19.1K	619	3400	100	
	-3	-503	55	16	6.65	4.2	-	29.4K	787	2100	100	
	-4	-504	55	16	6.65	1.029	-	29.4K	787	2100	100	
	-5	-505	55	16	6.65	1.029	3400	19.1K	619	3400	100	
	-6	-506	55	16	6.65	4.2	-	29.4K	787	2100	100	
	-8	-508	55	16	6.65	5.0637	-	29.4K	787	2100	100	
30365389-9		-509	55	16	6.65	1.3 to 1.7*	-	29.4K	787	2100	100	2.7K

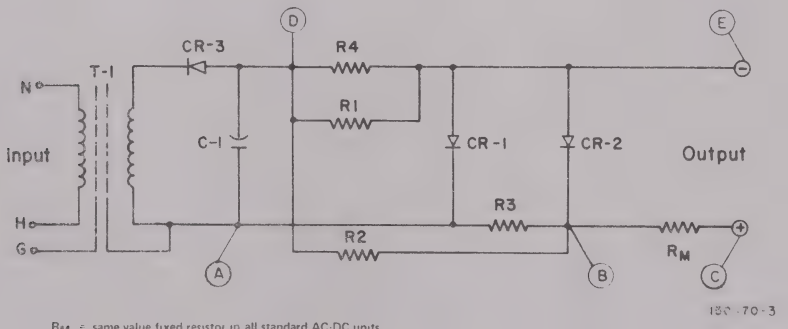
*Installed with load.

RESISTANCE CHECKS

1. Disconnect line voltage source.

2. Discharge capacitor C1. If checking an AC-DC unit, also discharge C2.

3. Use a multimeter to check resistances. Values should be as specified in Table 1. See Figure 3.



R_M = same value fixed resistor in all standard AC-DC units.

Figure 3. Schematic Diagram.

SOLID STATE AMPLIFIER REPLACEMENT

SERVICE

Should faulty operation be traced to the amplifier, we recommend that the amplifier be replaced as a unit. The printed wiring board can be replaced as follows but only an experienced service man should do so. Amplifier components can be identified from the enclosed amplifier parts list section.

1. Disconnect and remove amplifier
2. Remove amplifier cover.
3. Disconnect output cable
4. Remove and replace amplifier board (supplied with gain pot).
5. Reverse steps 1 to 4 using replacement board.
6. Install and reconnect amplifier.

1. SERVICE NOTES

a. If the instrument is erratic in operation and the pen jitter cannot be eliminated with proper adjustment of instrument sensitivity, a dirty or damaged slidewire may be suspected. A small amount of random motion at the motor pinion is normal and satisfactory. This is caused by a dither signal which should not, however, produce pen motion. The erratic motion may show up as random noise and may extend over as much as 20% of scale peak to peak.

b. Examination of the slidewire and contactor may indicate that the slidewire should be replaced. Look for excessive wear of the contactor. This will indicate a rough spot on the slidewire or a loose or distorted convolution. If none of the above causes are detectable and the erratic pen motion still persists, clean the slidewire as described below. If operation is not improved, replace the slidewire and contactor.

2. CLEANING

Clean the slidewire when required. To gain access to the slidewire loosen the knurled knob on the slidewire housing and swing the entire compartment up. Clean the slidewire with naphtha or a lead-free gasoline. Use a stiff bristle brush to clean between the slidewire convolutions. Oiling of the slidewire is not recommended.

WARNING: Good ventilation and adequate precaution are essential when using inflammable, volatile cleaning agents.

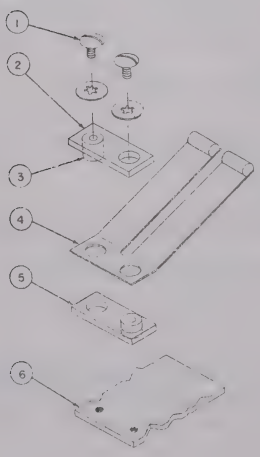


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Figure 1. Assembly of Slidewire Contactors

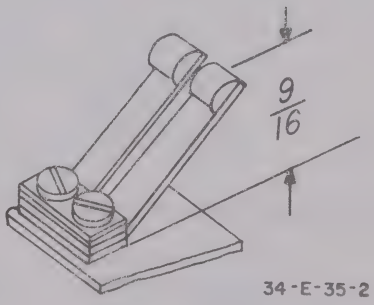


Figure 2. Slidewire Contactor

LEGEND

1. RETAINING SCREWS
2. UPPER INSULATOR
3. INSULATOR SLEEVE
4. CONTACTOR ASSEMBLY
5. LOWER INSULATOR
6. CARRIAGE ASSEMBLY

643-0014-153

3. REPLACING CONTACTOR ASSEMBLY

a. If the slidewire contactor assembly is severely worn, replace the assembly as follows:

(1) Remove the two screws which secure the contactor assembly to the pen carriage.

(2) Retain the insulating sleeves from around each screw and the two bakelite insulator strips. Discard the worn assembly.

(3) Reassemble the insulators with the new contactor assembly.

CAUTION: When reassembling, be sure that the two insulator sleeves are correctly placed around the screws and through the holes in the insulator strips and the contactor assembly. Incorrect reassembly may ground out the feedback signal and make the instrument inoperative. (Refer to figure 1).

(4) Attach the contactor assembly to the pen carriage and tighten the two screws.

b. Check the contactor pressure and adjust if necessary, as described in the following paragraph.

4. ADJUSTING CONTACTOR PRESSURE

a. Measure the distance between the top of the contactors and the surface of the pen carriage, as shown in fig. 2. Correct pressure of the contactors on the slidewire will be obtained when this distance is 9/16". If necessary carefully bend the spring arms of the contactors to obtain the correct distance.

b. Check the alignment of the contactors as follows:

(1) Close the slidewire compartment cover and tighten the knurled screw.

(2) Set the pen carriage at the middle of the scale.

(3) The contactors are correctly aligned when the slidewire and the collector touch the contactors at the middle of the contactor surfaces.

(4) Set the pen carriage successively at each end of the scale. As the pen carriage is moved to each of these positions, the point of contact should move across the face of the contactors.

(5) If the contactors are not correctly aligned, proceed as follows:

(a) Loosen the knurled screw and raise the slidewire compartment cover

(b) Loosen the two screws which hold the contactor assembly to the pen carriage and reposition the contactor assembly as required. Repeat steps (2) and (3) above.

c. Check the instrument zero adjustment.

5. CHECKING RESISTANCE

a. Swing the cover of the slidewire compartment up. Unsolder the yellow-black lead from lug No. 2 and the yellow-red lead from lug No. 3.

CAUTION: Do not unsolder shunt spool leads (see figure 3).

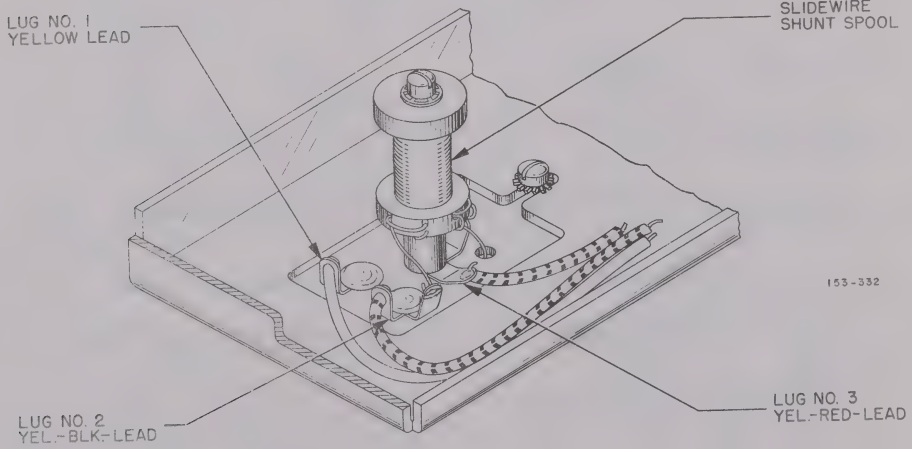


Figure 3. Slidewire Connections

b. Connect an ohmmeter between lugs 2 and 3. Adjust the meter to a suitable value for measuring the resistance of the applicable slidewire (e.g., 0-25 or 0-50 ohms for 20-ohm slidewire 355112-5). The correct resistance of various slidewires is given in Table I.

c. If slidewire resistance is correct, resolder the yellow-black and yellow-red leads to lugs 2 and 3.

d. If slidewire resistance is incorrect, replace slidewire as described in paragraph 6.

TABLE I

Part No.	Slidewire Resistance Used On	Resistance (ohms)
355112-1	ElectroniK 14 Recorders	20
355112-4	ElectroniK 15 w/High Resistance SW (special)	250
355112-5 (130 turns)	Std. ElectroniK 15 Recorders except as noted below	20
358770-1	Std. ElectroniK 15 Function Plotters and Extended Range Recorders	20
361544	Double Range Instruments	20

6. REPLACING SLIDEWIRE

a. Unsolder yellow, yellow-black, and yellow-red leads from lugs 1,2, and 3 (figure 3).

b. Support slidewire while removing the four slidewire mounting screws. Remove slidewire.

c. Insert new slidewire and secure with the four mounting screws.

d. Solder yellow-lead to lug 1, yellow-black lead to lug 2, and yellow-red lead to lug 3.

e. Recalibrate the instrument.

CHART DRIVE

SERVICE

1. CHECKS AND ADJUSTMENTS

a. CHART REROLL CHAIN

(1) The chart reroll chain (Fig. 1) drives both reroll spindles (in opposite directions) and is factory adjusted initially. Check for proper adjustment as follows:

(a) Chart plate is held in place by spring clips at rear; to free plate, insert fingers behind upper corners and pull outward. Swing chart plate down.

(b) Feel chart reroll chain to be sure that tension is not great enough to bind but that there is no slack.

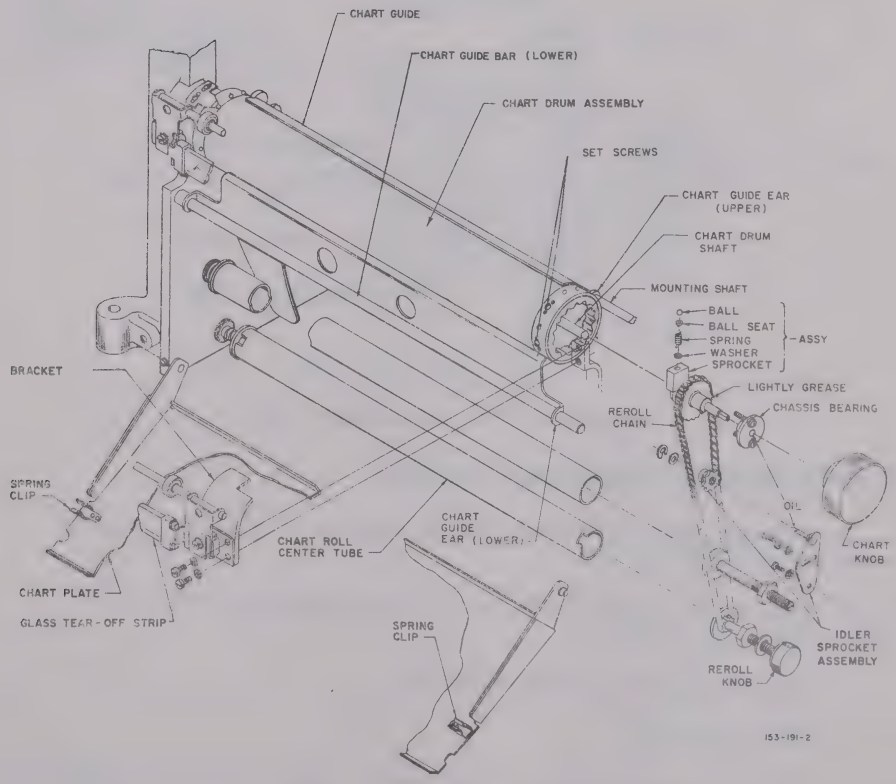


Figure 1. Strip Chart Drum Assembly with Ratchet Reroll

(2) If chart reroll chain is too tight or too slack, adjust as follows:

(a) Loosen mounting screws in upper idler sprocket bracket.

(b) Adjust idler sprocket to permit it to bear more or less tightly on the chart reroll chain as required.

(c) Tighten screws to hold bracket in correct position. Check to make sure that the reroll chain moves freely without binding, in BOTH directions. If not, readjust the idler sprocket.

b. **REROLL SPINDLES**. The proper dimension between the edge of the casting and the inner edge of each reroll spindle rim is 9/16-inch (Fig. 2), and is factory set initially. Check for this dimension, and if necessary, loosen the locknut and turn the knurled disc until the proper dimension is obtained. Tighten the locknut.

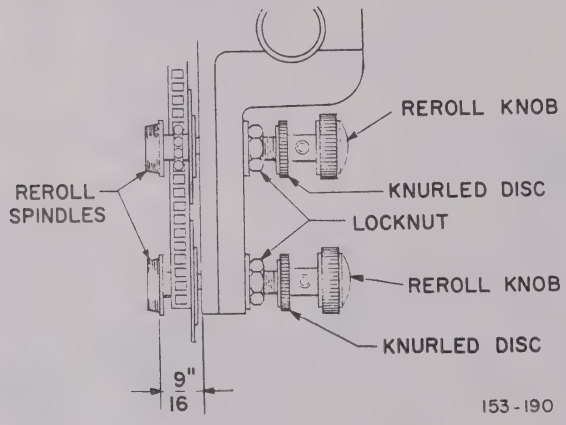


Figure 2. Lower Right-Hand Side of Chassis

2. REPLACEMENT OF CHART DRUM ASSEMBLY

a. Remove tear-off strip and chart retaining rollers and shaft by removing brackets (Fig. 1).

b. Loosen two setscrews in end of chart drum (see "setscrew adjustment", fig. 1 and 3).

c. Loosen setscrew in drive sprocket.

d. Withdraw shaft.

e. Disengage drive sprocket from reroll chain and remove chart drum from instrument.

f. Re-engage drive sprocket in reroll chain and hold new chart drum and drive sprocket in mounting position. Make sure pin on drive disc on left-hand end is properly engaged in slot of disc on that end of chart drum.

g. Push shaft through bearing, drive sprocket, and chart drum. Push shaft all the way through chart drum, until it stops against the bearing in the left-hand end casting.

h. All setscrews must bear on flats of shaft, therefore turn chart knob or the drum, and also the drive sprocket until all setscrew holes have the same angular position as those in the chart knob. Tighten setscrews in chart drum and drive sprocket, at same time establishing the .003-inch clearance shown in Fig. 3.

i. Remount tear-off strip and chart retaining rollers.

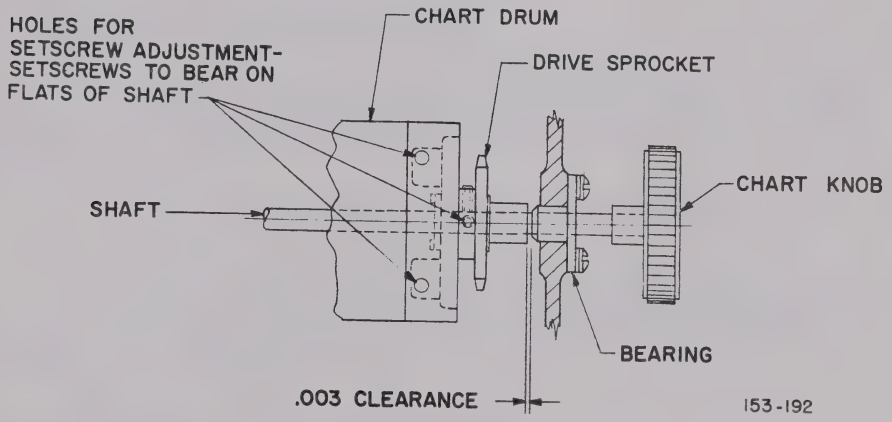


Figure 3. Chart Drum Mounting, right-hand end.

1. SELECTING INK

a. Remote reservoir capillary pen systems are designed for use with Honeywell Type 130 ink. This ink is satisfactory for most applications. It is relatively quick-drying, is suitable with all pen speeds, and can be used with chart speeds from 1/2 inch per hour to 4 inches per second and faster.

b. In applications where a combination of rapidly fluctuating variable and slow chart speed causes excessive retrace of the record, a slower drying ink may be required to prevent chart tear-through. Refer to Table I for ink selection; if tear-through is a problem, try the next slower drying ink until satisfactory operation is obtained (see para. d. and figure 1).

NOTE: Never mix Honeywell ink with ink from other vendors. Never mix different types or colors of Honeywell inks.

2. MAINTENANCE RECOMMENDATIONS

a. Satisfactory recording is based on the assumption that the user follows normal maintenance procedures for pens, and that ink and paper are handled with care. We strongly urge that the recommendations given below be followed for all recording systems:

(1) Use the ink which best meets the oscillating characteristics of the application (see Table I).

(2) Keep the chart clean and packed in its box until it is to be used. Store charts away from very humid or very dry atmospheres, and away from extreme temperatures. Ideal storage environment is 75°F and 50% RH.

(3) Handle the chart as little as possible.

(4) Handle the pen mechanism with care. Keep the pen tip clean, as described in the Operation Section for the pen.

(5) Handle all inks with care to prevent contamination. Keep the bottles tightly capped when not in use.

(6) Store ink bottles out of direct sunlight and away from abnormal ambient temperatures.

(7) When an instrument is to be out of service for an extended period of time, clean the pen system as described in the Pen Operation Section. Do not refill until ready to start up again.

3. TROUBLESHOOTING

a. TROUBLESHOOTING CHART. Table II lists the more common recording problems, their probable causes, and suggested remedies.

b. **PEN TIP PRESSURE.** Insufficient pressure can cause stopping or clogging; too much pressure can cause chart tear-through. Refer to the illustration in the Pen Operation Section which shows the leaf spring on the pen carriage. Use a gram-gage to measure pen tip pressure. If necessary, bend the leaf spring to produce the required pressure for satisfactory operation.

Instrument Pen Speed	Correct Pen Tip Pressure
24, 12, 4.5, 2 seconds	2+2-0 grams
1, 1/2, 1/4 second	10+2 grams

NOTE: In adjusting the leaf spring, make sure to leave no clearance between the spring ends and the pen assembly.

c. **LEAK CHECK.** Air bubbles are most likely caused by air trapped in the ink coming out of solution as the temperature of the ink increases. Bleed the capillary tubing of all air bubbles after normal operating temperature is reached. To prevent bubbles in the capillary tubing, always refill the reservoir when the bottle is still 1/4 full. Then, as the ink heats up in the reservoir, trapped air will escape to atmosphere before the ink enters the capillary tubing.

d. **DETERMINING CORRECT TYPE OF INK**

In applications with retracing records, determine correct type of ink as follows:

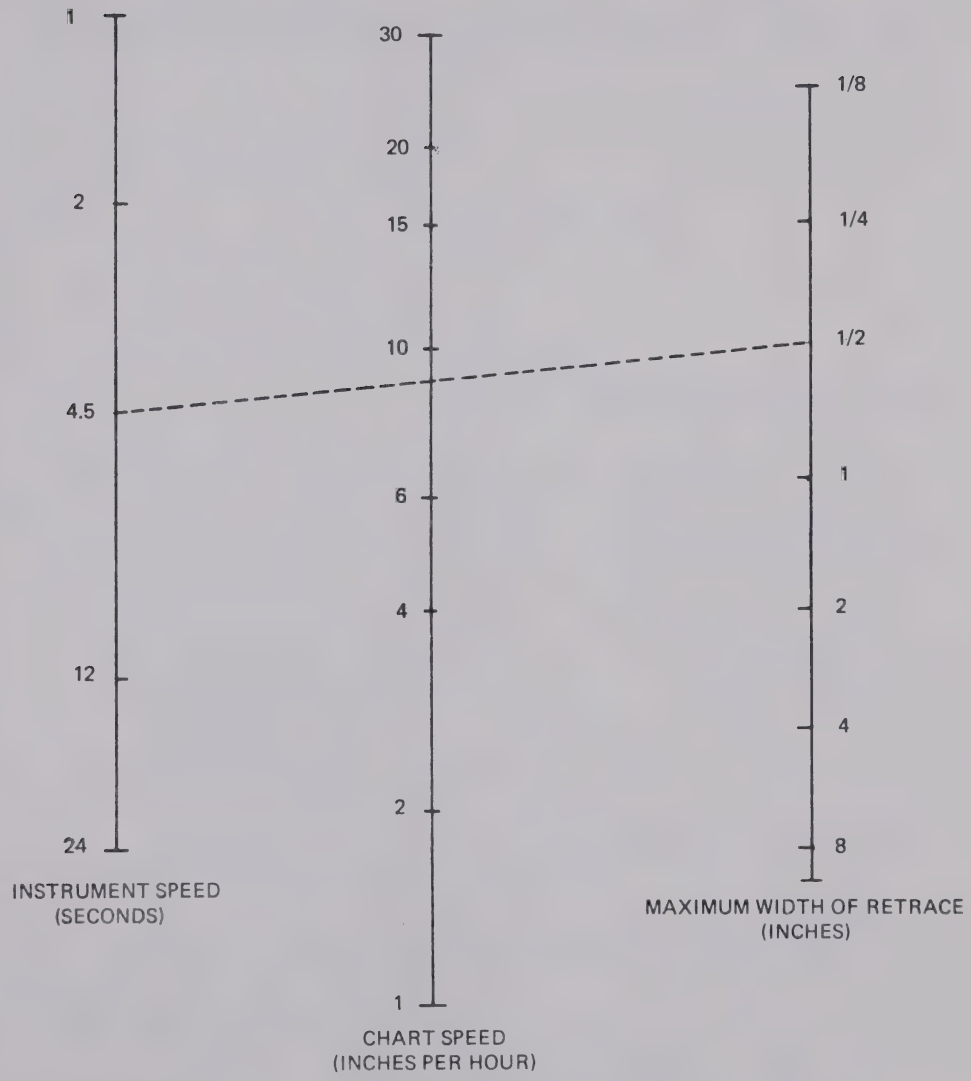
(1) Refer to figure 1. Draw a line from the pen speed (left-hand line) to the maximum width of the record (right-hand line).

(2) If the chart speed (middle line) is above the line drawn and the type of ink being used does not perform satisfactorily, change to a faster drying ink.

(3) If the chart speed is below the line drawn and the ink used is not performing satisfactorily, change to a slower drying ink.

INK SELECTION GRAPH
FOR CAPILLARY PEN RECORDING SYSTEMS

For Use with Retracing* Type Records



* A retracing record is one in which the lines overlap, that is, individual traces are not distinguishable.

Figure 1. Ink Selection Graph for Retracing Records

TABLE I

HONEYWELL INKS FOR REMOTE RESERVOIR CAPILLARY PENS

TYPE	CHARACTERISTICS
TYPE 130 INK (non-reproducing) 366316-1 Red -2 Purple -3 Green	First choice for remote reservoir pens 1. Glycerine content 13% 2. Flows freely 3. Will not feather or spread 4. Dries much faster than general purpose ink 5. Pen can retrace to a limited extent without chart tear-through 6. Does not dry in pen tip if pen is lifted from chart over a weekend
TYPE 130 INK (reproducible) 366124-1 Orange-red -2 Black	Use only when required to reproduce chart records by the Ozalid or other process using ultraviolet light
GENERAL PURPOSE INK B-15234 Red 74637-1 Purple B-12779 Green 361079 Black 301533 Blue	1. Glycerine content about 26% 2. Slower drying than Type 130 3. Can be used for records with medium retracing (slow chart speeds and high pen speeds) without chart tear-through 4. Flows less freely than Type 130 5. Lower freezing point than Type 130
SLOW-DRYING INK B-17662 Red B-17663 Purple B-17664 Green	1. Glycerine content about 60% 2. Used primarily for high and low ambient temperature applications 3. Pen can retrace as much as required without tear-through 4. Dries very slowly -- care must be exercised to prevent smearing of record 5. Flows less freely than either Type 130 or General Purpose ink.

TABLE II

TROUBLESHOOTING (cont'd)

PROBLEM	PROBABLE CAUSE	REMEDY
Tearing, feathering, scuffing, bleed-through	Repeated retracing of record by pen	1. Refer to Selection Table to determine if the proper ink is being used for the application. Use slower drying ink if possible. 2. Increase chart speed to decrease retrace. 3. Check: (a) Tip for damage (use a 5-power magnifying glass. Replace if chipped, cracked, or sharp-edged) (b) Tip force (par. 3. b.) (c) Instrument noise (indicated by constant and excessive vibration). Ground instrument. If noise persists consult nearest Honeywell branch for other solutions. (d) Tip-paper alignment. (The tip should be perpendicular to the paper)
Skipping	High pen speed; pen not aligned; pen pivots too tight	Make sure that pen tip is perpendicular to paper in all planes. Check pen pivot and, if necessary, adjust for free bearing fit without excessive play.
	Instrument noise indicated by constant, excessive vibration	Ground instrument. If noise persists, consult nearest Honeywell branch for other solutions.
	Insufficient pen tip pressure.	Adjust pen tip (see para. 3. b.).
	Low head (ink level too far below level of pen tip).	Increase level of ink in reservoir.
	Type of ink	Check Table I to see if recommended ink is being used. If it is, change to ink with lower glycerine content.
	Chart	Check for excessive dust and protruding fibers. Change chart.
Record reproduces on back of chart.	Type of ink.	Use faster drying ink.
	Ink flow too fast.	Reduce pen pressure (see para. 3. b.).
	Evaporation	If correct ink is being used but the drying rate is slower than normal, add water to reservoir (amount depending on desired color intensity of record).

TABLE II

TROUBLESHOOTING

PROBLEM	PROBABLE CAUSE	REMEDY
Stopping or little flow	Dirt or growth in ink.	Check ink supply. Clean and reink if dirt or growth found. Also check ink in storage. Make sure bottle is tightly capped and stored under recommended conditions.
	Insufficient pen tip pressure.	Adjust pen tip position (par. 3. b.)
	Insufficient ink	Fill reservoir (see par. 3. c.)
	Vent hole clogged	Clean vent hole; it must be open to atmosphere for satisfactory pen operation.
	Air bubbles	Check tubing for cuts and cracks due to age. If defective, replace tubing. Check tubing connections for leaks which allow air to enter. Inks with high glycerine content (slow-drying) are prone to develop air bubbles; if problem persists go to next faster drying ink. Also see para. 3. c.
Clogging	Evaporation	If the instrument is used intermittently or in high temperature, too rapid evaporation may occur between fillings. Use slower drying ink if possible. Establish tighter cleaning and filling schedule.
	Ink dries often at pen tip.	Clean more often. Change to general purpose or slower drying ink.
	Accumulation of paper fibers at pen tip.	1. Use slower drying ink to minimize penetration of ink and abrasion. Increase chart speed if possible. 2. Examine pen tip for chipping, cracking, sharp edges, and burrs. Replace tip. If injury to tip is caused by instrument noise, try grounding instrument. If noise persists, consult nearest Honeywell branch for other solutions. 3. Examine chart for protruding fibers or excessive dust. Change chart.
	Evaporation due to high ambient temperatures.	Add a small amount of water to reservoir. Amount depends desired color intensity of record.
Flooding	Positive head (ink level in reservoir higher than level of pen tip)	Instrument not level. Check and correct.
	Too much pressure at pen tip.	Decrease pressure (see para. 3. b.), particularly if using slow chart speed.
	Type of ink.	Change to ink with higher glycerine content (flow rate is slower).
	Chart speed.	Reduce chart speed if possible.
Wide record line.	Pen tip.	Check diameter of tip. If it appears large, replace tip.
	Evaporation causing build-up of solids around exterior of pen tip.	Add water to reservoir, amount depending on color intensity of record.

INDEX DRIVE CABLE

SERVICE

1. CABLE REMOVAL.

a. Loosen clamping screw in set point index (Figure 1) and disengage cable from index.

b. Remove screw from center of index knob Remove the knob.

c. Slip end of cable out of slot in index knob.

d. Remove cable from pulley at left end of scale.

e. Unwind cable from cable drum and slip end sleeve out of cable drum slot.

f. Remove cable, taking care not to kink it.

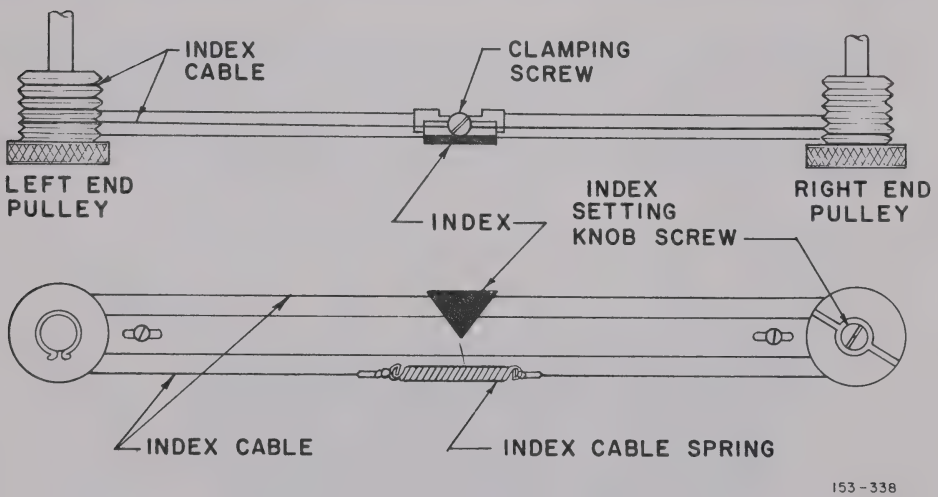


Figure 1. Strip Chart Single Control Index.

2. CABLE INSTALLATION

a. Take end of longer section of cable and place end sleeve in slot of cable drum so that it catches in slot.

b. Swing chassis out of case.

c. Turn small knurled pinion on end of cable drum shaft to counter-clockwise limit.

d. Wind cable 4-1/2 turns counterclockwise in grooves around drum.

e. Bring cable over pulley at left end of scale.

f. Bring short, end of cable over cable drum one half turn counter-clockwise.

g. Slip cable sleeve through slot in index knob.

h. Assemble index knob to cable drum with screw but do not tighten it.

i. Hold drum and turn index knob until take-up spring in cable is stretched approximately 0.5 inch beyond its relaxed length.

j. Tighten screw to hold index knob in position.

k. Turn index knob until take up spring is at approximately mid-scale

l. Move set point index by hand until it is at approximately mid-scale.

m. Place drive cable under cable clamp and fasten it in place.

n. Refer to "ALIGNMENT OF PEN AND SET POINT INDEX" in contact control components service section and check alignment.

1. TROUBLESHOOTING

a. GENERAL. Troubleshooting consists of checking visually for obvious defects, and an electrical check, if necessary.

NOTE: Refer to the selector switches and timing mechanism service section. Perform the alignment checks and adjustments given there before following any of the troubleshooting procedures contained in this section.

b. VISUAL CHECKS.

(1) MAKE SURE INSTRUMENT IS LEVEL. Check chassis latch adjustment as described in instrument installation section.

(2) Inspect switch mechanism (fig. 1) for disconnected, broken or missing parts.

(3) Inspect switches and mounting strip for damage. Make sure the glass tubes are not cracked or broken.

(4) If a switch has been rotated in its clip, it may fail to make contact. Make sure switches are properly positioned (with the "UP" label upward) and securely cemented in their clips.

(5) Check switch leads. They should not be wedged against the switch clips nor restrict motion of switches at any point.

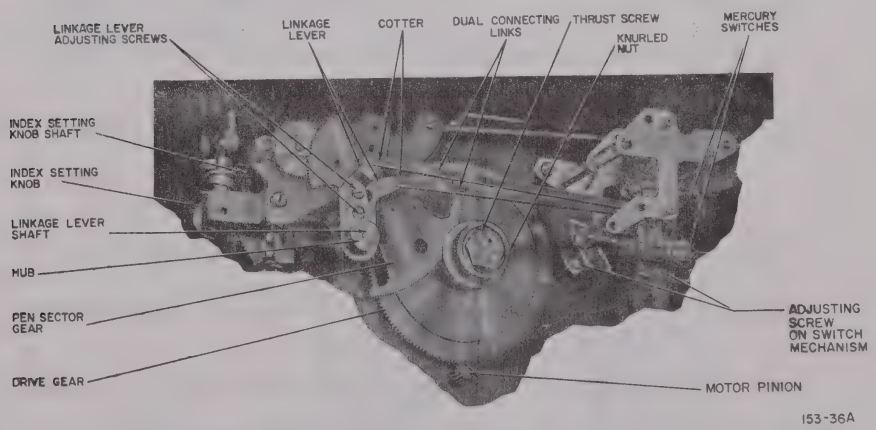


Figure 1. Rear view of Strip Chart Chassis showing Dual Contact Control Mechanism

c. ELECTRICAL CHECKS

WARNING: To avoid shock hazard, switch off instrument power and deenergize the control circuits.

(1) Inspect for loose or broken connections at the terminal block.

(2) Refer to the wiring diagrams included in this manual and connect an ohmmeter to each set of terminals in turn. Check for proper switching action by rotating the drive gear (fig. 1) to move pen past set point index. Also observe the mechanism for proper mechanical action. Replace defective parts and refer to para. 2 below.

2. OPERATIONAL CHECK AND ADJUSTMENTS

a. GENERAL Proper switching action at the control point depends on correct alignment of operating points in relation to the set point index and on correct setting of the neutral zone.

b. PROCEDURES. All procedures required to obtain desired switching action are listed below. Perform the checks and adjustments in the order listed.

(1) ALIGNMENT OF SET POINT INDEX TRAVEL

(a) Check for correct travel by turning index knob clockwise to stop, then counterclockwise to stop.

(b) When index travel is correct, set point index is at approximately 98 per cent of full scale in full clockwise position of knob and at approximately 2 per cent below bottom of scale at full counterclockwise limit.

(c) If upper limit of set point index travel is not 98 per cent of full scale, proceed as follows:

1. Turn index setting knob clockwise against stop.

2. Loosen clamping screw in index cable clamp.

3. Move index along cable until it stands at approximately 98 per cent of full scale.

4. Tighten clamping screw in index cable clamp.

(2) ALIGNMENT OF SET POINT INDEX AND DIFFERENTIAL MECHANISM

(a) Align set point index and pen and pointer at 50 per cent of full scale.

(b) Refer to fig. 1. Disconnect connecting link(s) from linkage lever(s). On dual mechanism single-index controllers, loosen upper or lower linkage lever adjusting screw and align by sight the link holes in the levers. If necessary, loosen both linkage lever adjusting screws. Tighten screws after alignment is achieved.

(c) Set point index and differential mechanism are correctly aligned when a No. 47 drill or a 0.078-inch pin can be inserted through link hole(s) in linkage lever(s) and hole in bearing hub.

(3) ALIGNMENT OF SWITCH MECHANISM AND LINK LEVERS

(a) Align set point index and pen and pointer at 50 per cent of full scale.

(b) Switch mechanism and link lever(s) are correctly aligned when the following three parts of the switch mechanism (of each mechanism on dual mechanism) are vertical. These parts are shown in figure 2.

1. Switch mounting plate(s)

2. Driving lever(s)

3. Slotted lever(s)

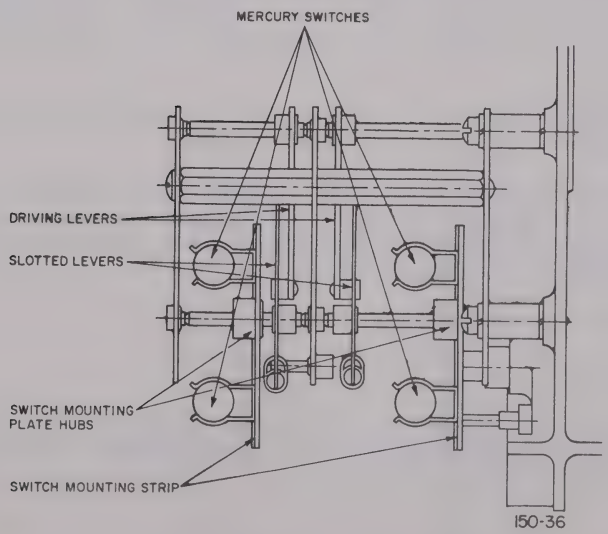


Figure 2. Side view of Mercury Switch, Control Unit

(c) If switch mechanism(s) and link lever(s) are not correctly aligned, first make sure the connecting link is in the upper hole of driving lever on single mechanism or that links are in lower holes of driving levers on dual mechanism.

(d) Loosen switch mechanism mounting screws and move mechanism right or left to bring driving lever(s) and slotted lever(s) vertical.

(e) Tighten mounting screws.

(f) Loosen setscrews in hub on switch mounting plate (fig. 2) and align the mounting plate with driving lever and slotted lever.

(h) Tighten setscrews in hub of switch mounting plate.

NOTE: These alignments on dual switch mechanism are designed to permit full use of adjustment provided by adjustable link levers for obtaining desired switching action.

(4) SWITCH ALIGNMENT (SINGLE MECHANISM)

(a) Align pen (move pen manually by turning drive gear) and set point index at 50 per cent of full scale.

(b) Loosen adjusting screw (fig. 1) and change position of switch to obtain desired switching action. Switch plate has two tapped holes at each clip; if sufficient adjustment cannot be obtained with screw in first hole, move screw to second hole.

(c) Refer to separate contact control operation section and adjust width of neutral or other zone.

(d) Check adjustments by first realigning pen and index then by moving either the pen or index while observing switching action. If desired switching action has not been obtained, readjust as described above.

(5) SWITCH ALIGNMENT (DUAL MECHANISM)

(a) Refer to fig. 1.

(b) Loosen lower adjusting screw and move inner linkage lever to desired operating point for corresponding switch assembly. Tighten lower adjusting screw.

(c) Loosen upper adjusting screw and move outer linkage lever to desired operating point for corresponding switch assembly. Tighten adjusting screw.

NOTE: With both adjusting screws loosened, both linkage levers can be rotated simultaneously, within the limits of their slots.

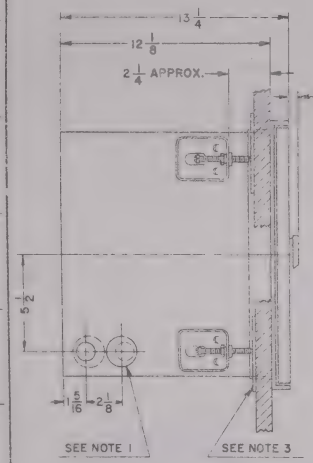
(6) ALIGNMENT OF SET POINT INDEX AT CONTROL POINT. Alignment under par. 2,b, (4) or par. 2,b, (5) is made with the chassis swung out of the case and possibly inclined slightly from the normal (in case) operating position, which is presumed to be level. The angle will probably be large enough to disturb switch alignment, in operation. To compensate, proceed as follows:

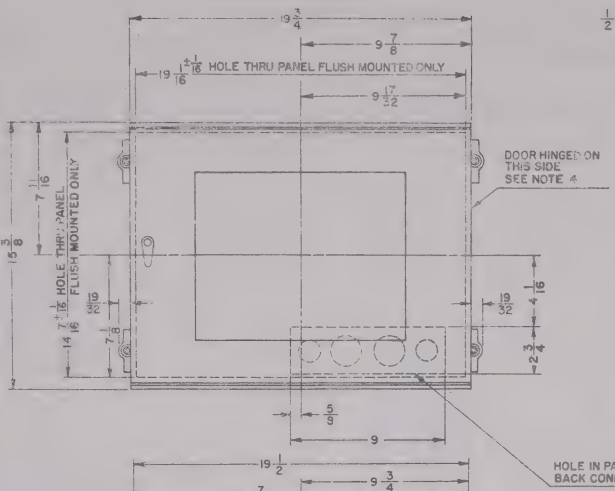
(a) Put control system in operation. Move set point index to desired value and permit instrument to line out at the control point.

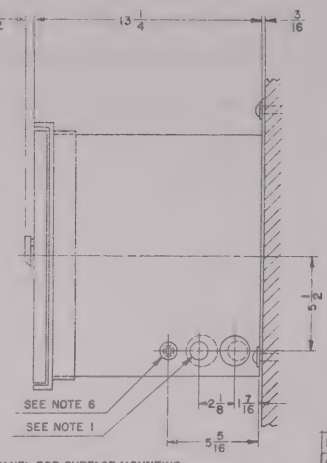
(b) If control point does not coincide with the desired value, loosen clamping screw and move index to coincide with the control point. Tighten clamping screw.

NOTE: If it is necessary to move the index more than 5 per cent of full scale, first check adjustment of control mechanism as directed under par. 2,b, (4) or 2.b,(5) and readjust, if necessary.

REFERENCE DRAWINGS



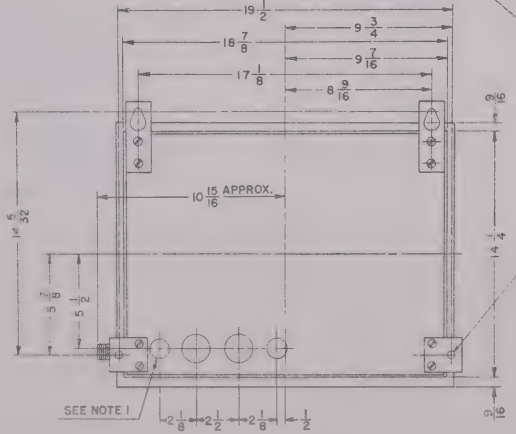




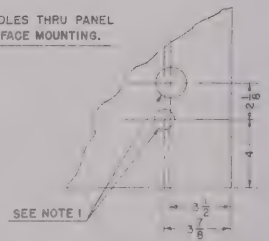
HOLE IN PANEL FOR SURFACE MOUNTING BACK CONNECTED ONLY

NOTES:

1. FIVE 1 3/4" DIA. HOLES FOR 1 1/4" CONDUIT CONNECTIONS.
   FIVE 1 1/8" DIA. HOLES FOR 3/4" CONDUIT CONNECTIONS.
2. CHECK CLEARANCE WITH ADJACENT INSTRUMENTS TO PREVENT GLASS BREAKAGE.
3. METAL PLATES SUPPLIED WITH ACCESSORIES ARE FOR USE WHEN INSTRUMENT IS FLUSH MOUNTED ON A SLATE OR EBONY ASBESTOS PANEL. PLACE PLATES BETWEEN PANEL AND MOUNTING SCREWS TO PREVENT CHIPPING OF PANEL.
4. DOOR SWINGS OPEN 120°.
5. CHASSIS HINGES AT LEFT AND OPENS 150°. MOUNT INSTRUMENT WITH CENTER LINE AT LEAST 27 1/2" FROM WALL OR ANY OBSTRUCTION ON THE LEFT.
6. 1/8" PIPE THREAD CONNECTION FOR AIR PURGE CONNECTION ON VENTED CASE MODELS ONLY. SUPPLIED ONLY WHEN SPECIFIED.



SURFACE MOUNTING
REAR VIEW



PARTIAL
BOTTOM VIEW

18	A-11-67 REMOVED NOTE 5, NOTE 6
17	IN NOTE 5 CHG. 180° TO 150° 9-7-66
16	12-4-63 EO 27330-690 NOTE 3 METAL PLATES WAS STEEL
15	6-12-62
	DR-4005-12G IN TITLE, ADD 13/4 DEEP CASE INC 4-2-60 ASM. NOTE
	DR 7372-74
13	9-29-59
	DR-7372-7A IN NOTE 1 "FIVE" WAS "FOUR" (-12) ADDED PARTIAL BOTTOM VIEW
12	7-15-59

REDRAWN WITHOUT CHANGE.

ISSUE NO. | ENGR | DATE

APP FOR RELEASE | ENGR | DATE

APP FOR VENDORY QUOTATION | ENGR | DATE

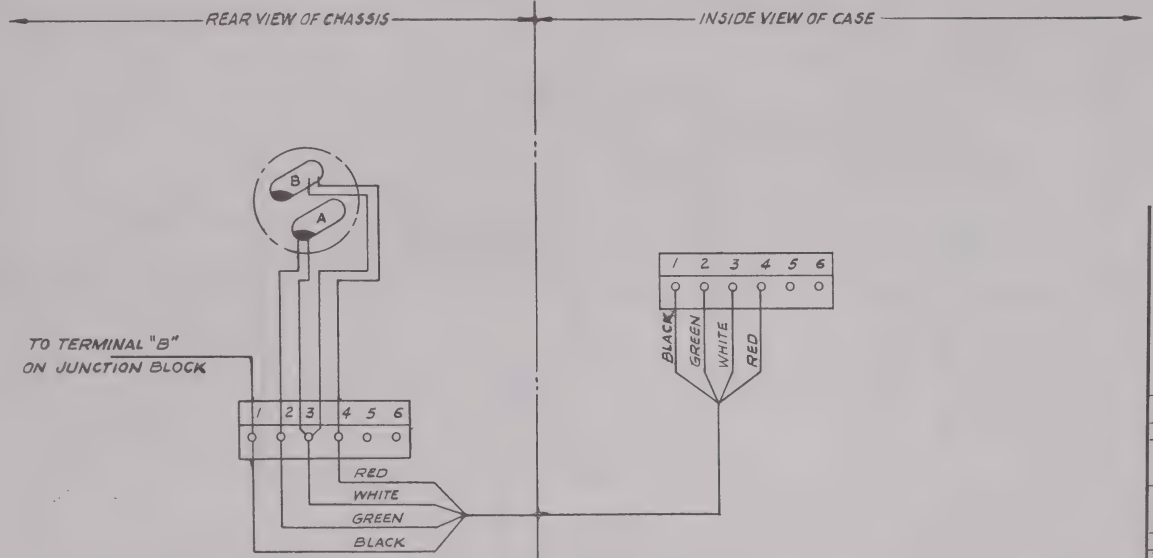
TOLERANCES UNLESS OTHERWISE SPECIFIED — LIMITS — ON DIMENSIONS WHERE LIMITS ARE NOT SHOWN USE THE FOLLOWING — ON ALL DECIMAL DIMENSIONS ± .005 — ON ALL OTHER LINEAR DIMENSIONS ± 1/64 — ANGULAR DIMENSIONS ±

DRAWN | CHECKED | APPROVED

DRILLING DIMENSIONS
(STRIP CHART)
ELECTRONIK RECORDER
13 1/4" DEEP CASE, CL15

MINNEAPOLIS-HONEYWELL REG. CO.

SIZE D | DRAWING NO. 12-6-68



369880

1. 1-7-63 WLM			
FORM NO. F-2148-A 2223			
ISSUE NO.			APP
APP. FOR RELEASE	ENGR.		DATE 1-4-63
	SECT. HD.		DATE
APP. FOR VENDORS QUOTATION	ENGR.		DATE
	SECT. HD.		DATE

a	b	c	d	e	f	g	h	i
TOKYO	✓	HENHOUSE	✓					
M-H								
TORONTO	✓							

REPRODUCTION LOCATED AT	JOB NOS.	USED ON
	2223	

LIMITS—ON DIMENSIONS WHERE LIMITS ARE NOT SHOWN USE THE FOLLOWING:—
ON ALL DECIMAL DIMENSIONS ± .005
ON ALL OTHER LINEAR DIMENSIONS ±1/64
ANGULAR DIMENSIONS ± 1°

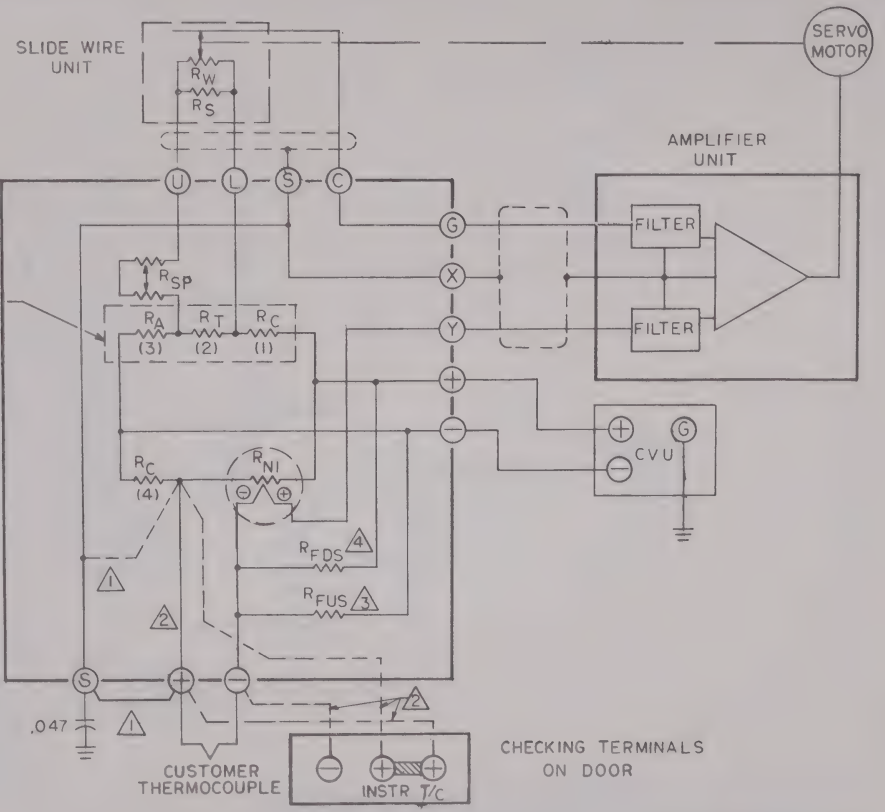
DES. ENGR.	DRAWN	CHECKED	APPROVED
	MP	WLM	

WIRING DIAGRAM-INTERNAL SUPPLEMENTARY WIRING CONTROL FORM 24, 28, OR 36 CL 15 SINGLE RECORD STRIP CHART RECORDER

MINNEAPOLIS-HONEYWELL REG. CO.
BROWN INSTRUMENTS DIVISION
PHILADELPHIA, PA., U. S. A. MP

SCALE	DRAWING NO.	CL.
NONE	369880	3
DATE 12-18-62		

J. H. WEIL MFG., PHILA.



4 - DOWNSCALE BURNOUT RESISTOR WHEN SUPPLIED
3 - UPSCALE BURNOUT RESISTOR WHEN SUPPLIED.
2 - ⊕ TERMINAL CONN BY THE SOLID LINE WHEN CHECKING TERMINALS ARE NOT USED BUT BY THE DOTTED LINES WHEN THEY ARE.
1 - GUARD SHIELD CONN IS PER THE SOLID LINE WHEN CHECKING TERMINALS ARE NOT USED BUT BY THE DOTTED LINE WHEN THEY ARE.

NOTES

REPRO LOC	DR R.C.FORD DATE 7-31-70	HONEYWELL INC. FORT WASHINGTON, PA., U.S.A.
CANADA	CHK DATE	
SCOTLAND	ENGR DATE	
GERMANY	MFG DATE	
JAPAN	ENGR MGR DATE	SCHEMATIC, MEAS CKT
FIRST USED ON 30682555 REF	DESIGN SUPVR DATE	UNIT QUICK RANGE CHG
SCALE NONE		T/C RCORDERS CL-15
MATERIAL		C 30682557-000 SHEET 1 of 1
FINISH		ENGRG. REF. 7119 AC 159

30682557-000

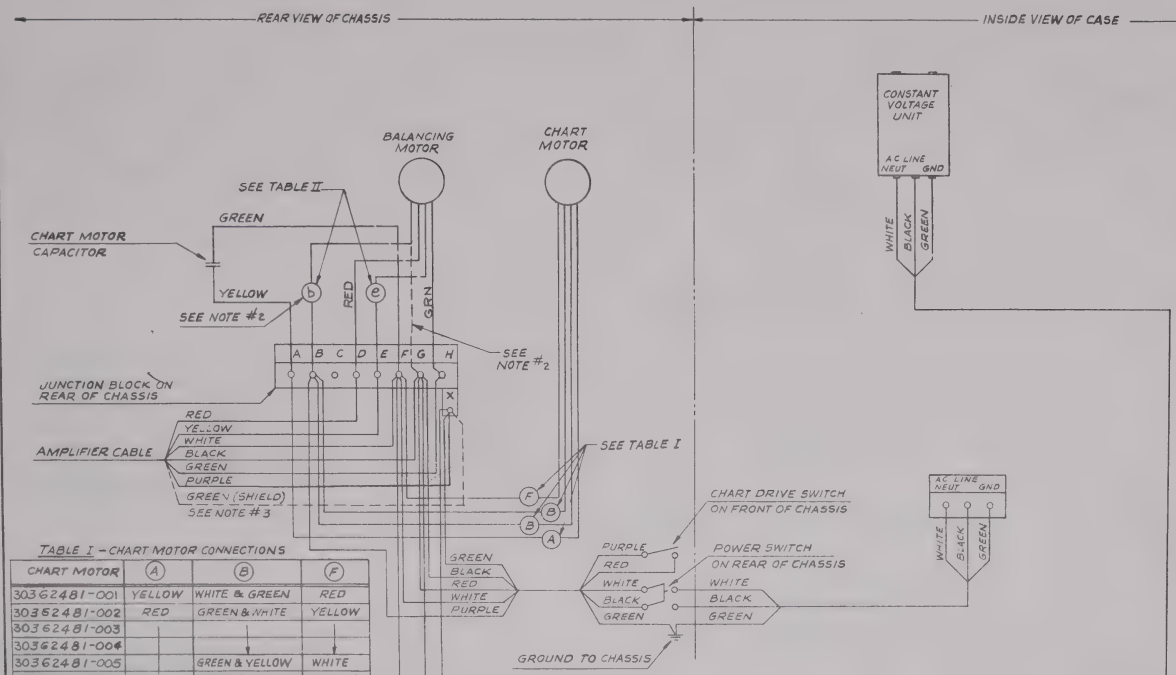


TABLE I – CHART MOTOR CONNECTIONS

CHART MOTOR	(A)	(B)	(F)
30362481-001	YELLOW	WHITE & GREEN	RED
30362481-002	RED	GREEN & WHITE	YELLOW
30362481-003			
30362481-004			
30362481-005		GREEN & YELLOW	WHITE
30362481-007		GREEN & WHITE	YELLOW

TABLE II – BALANCING MOTOR CONNECTIONS

BALANCE SPEED	RANGE	(b) LEAD COLOR	(e) LEAD COLOR	AMPLIFIER TYPE
1, 2, & 3	NORMAL	WHT	YEL	SOLID STATE
1, 2, & 3	REVERSED	YEL	WHT	

TABLE III – SUPPLEMENTARY DRAWINGS

TABLE VII OPTION	DWG. NO.
CHART ILLUMINATION (061; 062)	30363271-000
D.P.D.T. AUXILIARY SWITCH (096)	30363497-000
S.P.D.T. AUXILIARY SWITCH (092; 097)	30363498-000
S.P.D.T. AUXILIARY SWITCH (091; 094; 095)	30369864-000
OPERATION PENS (026 TO 031)	30363499-000
OMISSION OF POWER AND CHART SWITCHES (017; 019; 023; 025)	30369870-000
240 VOLT OPERATION (018; 024)	30363501-000
2 SPEED CHART DRIVE WITH CH. SW. (009; 010; 011; 012)	30369862-000
2 SPEED CHART DRIVE WITHOUT CHART SWITCH (013)	30369863-000
PRINT CRANK ACTUATED BAL. MOTOR CUTOUT SWITCH (-702)	30730180-001

NOTES:-

2. WITH THE BALANCING MOTOR CONNECTED TO TERMINAL "B", CHART DRIVE SWITCH TURNS OFF CHART AS WELL AS BALANCING MOTOR - THIS IS STAND BY OPERATION. IF BALANCING MOTOR IS CONNECTED TO TERMINAL "G", CHART DRIVE SWITCH DOES NOT AFFECT BALANCING MOTOR OPERATION AND WITH CHART DRIVE SWITCH IN OFF POSITION INSTRUMENT OPERATES AS AN INDICATOR.

3. IF AMPLIFIER CABLE IS PROVIDED WITH SHIELD WIRE, CONNECT THE GREEN SHIELD WIRE TO TERMINAL "X" AS SHOWN BY DOTTED LINES.

REF: 30369854

30682571

1. RELEASED 7-29-70 RS

ISSUE NO.		APP.
APP. FOR RELEASE	ENGR.	DATE
	SECT. NO.	DATE
APP. FOR VENDORS QUOTATION	ENGR.	DATE
	SECT. NO.	DATE

	a	b	c	d	e	f	g	h	i
TOKYO		✓							
M-H		WHITE							
TORONTO		✓							

REPRODUCTION LOCATED AT | JOB NOS | USED ON

LIMITS—ON DIMENSIONS WHERE LIMITS ARE NOT SHOWN USE THE FOLLOWING —
ON ALL DECIMAL DIMENSIONS ± .005
ON ALL OTHER LINEAR DIMENSIONS ±1/64
ANGULAR DIMENSIONS ± 1°

DES. ENGR.	DRAWN	CHECKED	APPROVED
WP 7/21/70	CTS	WLF 7/20	APC

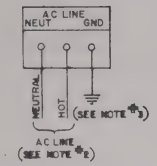
WIRING DIAGRAM INTERNAL INSTRUMENT POWER CIRCUIT CL. 15 SINGLE AND MULTI-RECORD STRIP CHART REC. WITHOUT DESENSITIZING (SOLID STATE AMPLIFIER)

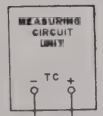
HONEYWELL INC.
ST WASHINGTON, PA U S A

SCALE	DRAWING NO	CL.
NONE	30682571	3
DATE 7-24-70		

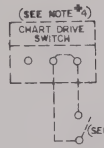
7119-00-172

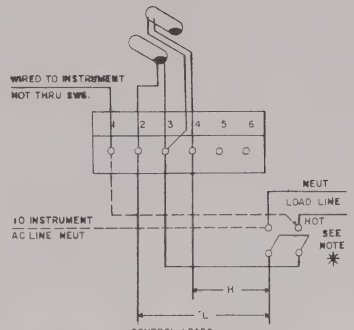
REPRODUCTION LOCATED AT		
MPLS		FALL RIVER
TORONTO		GERMANY
NEWHOUSE		TOKYO
AMIENS		

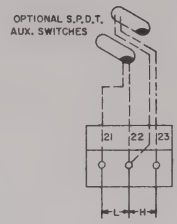




CONNECT TO
DETECTING UNIT TERMINALS
SEE NOTE *1







*
NOTE
IF CONTROL LOAD RATING IS SAME AS INSTRUMENT RATING AND IT IS DESIRED TO ENERGIZE LOAD THRU INSTRUMENT SWITCH, OMIT LOAD LINE AND CONNECT LOAD SWITCH TO TERMINAL 1 AND INSTRUMENT LINE NEUTRAL (AS SHOWN BY DASH LINES.)

CONTROL SWITCH ACTION

CONTROL FORM	LOAD ENERGIZED WHEN PEN IS		
	BELOW NEUT. ZONE	WITHIN NEUT. ZONE	ABOVE INDEX SETTING
024-028	L		H
036	L		H

OPERATION OF AUXILIARY SWITCHES

AUXILIARY LOAD	MERCURY SWITCH BETWEEN TERMINALS	SWITCH CLOSED WHEN PEN IS
L	21 & 22	BELOW L.H. SWITCH SETTING
H	22 & 23	ABOVE R.H. " "

NOTES.

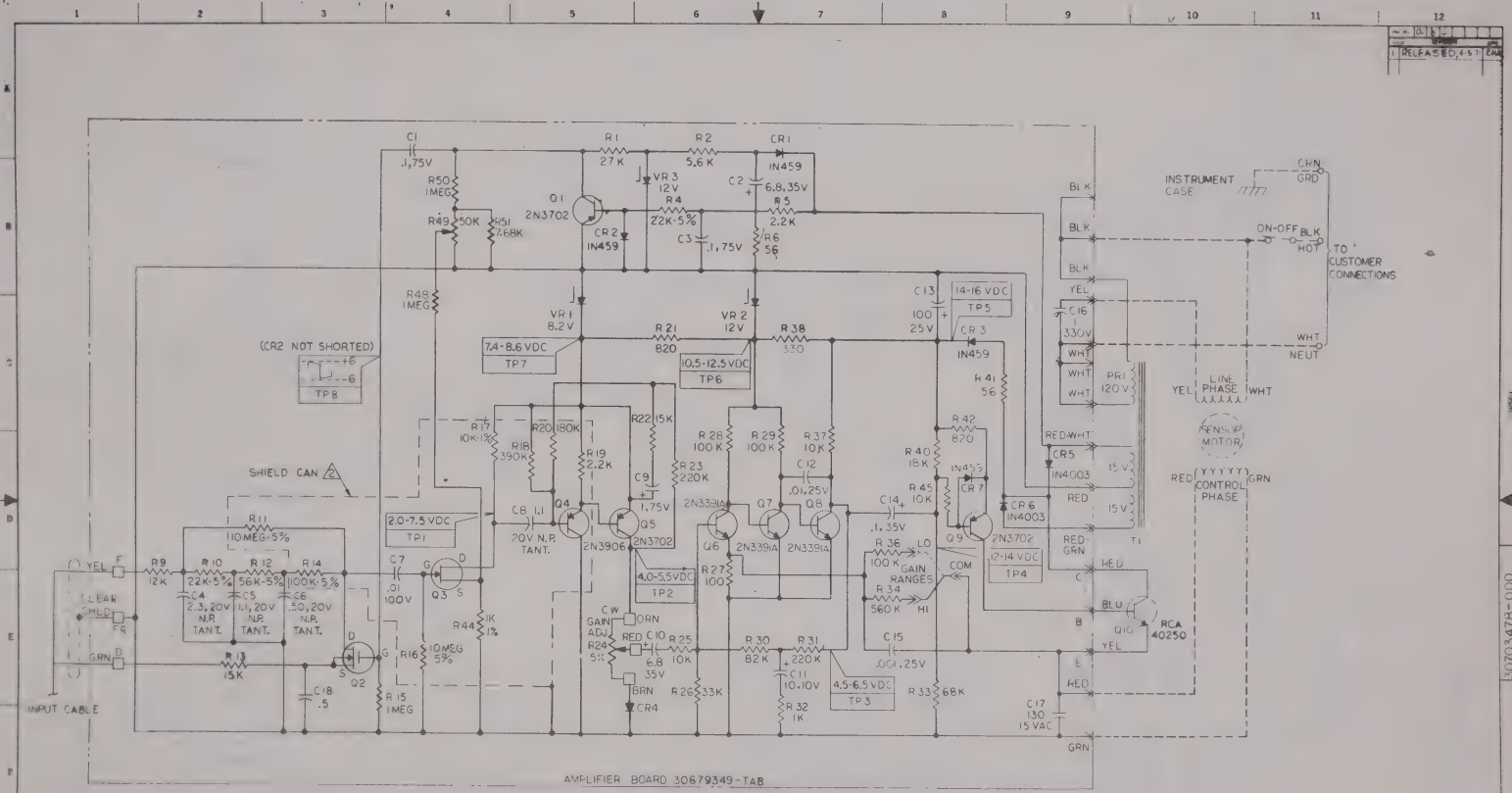
1. FOR RESISTANCE THERMOMETER CONNECT DETECTING UNIT PER 10-6-12.
2. LINE VOLTAGE IS 120 V.A.C. IF INSTRUMENT HAS OPTION OF INTERNAL 240 VOLT STEP DOWN TRANSFORMER, CONNECT TO L1 & L2.
3. GROUND SEPARATELY AND DIRECTLY TO ADEQUATE ELECTRICAL GROUND.
4. THIS TERMINAL BLOCK WITH JUMPER SUPPLIED ONLY ON INSTRUMENTS WITH OPTION OF EXTERNAL CHART SWITCH.
5. REMOVE JUMPER FROM INSTRUMENT TERMINAL BLOCK IF EXTERNAL CHART DRIVE SWITCH IS USED.

ISSUE NO.	BD 2295-500 10/19/62	MC
		APP.

MINNEAPOLIS-HONEYWELL
BROWN INSTRUMENTS DIVISION
PHILADELPHIA, PA., U.S.A.

WIRING DIAGRAM - EXTERNAL
CLASS 14 & 15 SINGLE PEN
CONTACT CONTROL
C.F. 024, 028, 036

SIZE	DRAWING NO.	
D	702646	3



5. DC VOLTAGES MEASURED WITH THE SOURCE VOLTAGE AT ZERO AND DIODE CR2 SHORTED. DC VOLTAGES ARE MEASURED WITH RESPECT TO CIRCUIT COMMON (FR) USING A VOLTMETER HAVING A 20,000 OHMS PER VOLT SENSITIVITY.

4. UNLESS OTHERWISE SPECIFIED:
(A) CAPACITANCE IN MICROFARADS
(B) RESISTANCE IN OHMS
(C) RESISTOR TOLERANCE 10%
(D) RESISTOR POWER RATING 1/2W
TEST POINTS (TP) ARE COMPONENT LEADS AND ARE MARKED ON AMPL. ASSY.
RESISTORS UNDER SHIELD CAN ARE 1/4W, [illegible] UNLESS OTHERWISE SPECIFIED.

1. ENG REF: AMPLIFIER BOARD ASSY 30679349-001

HONEYWELL
SERVO AMPLIFIER
SOLID STATE

30703478-000

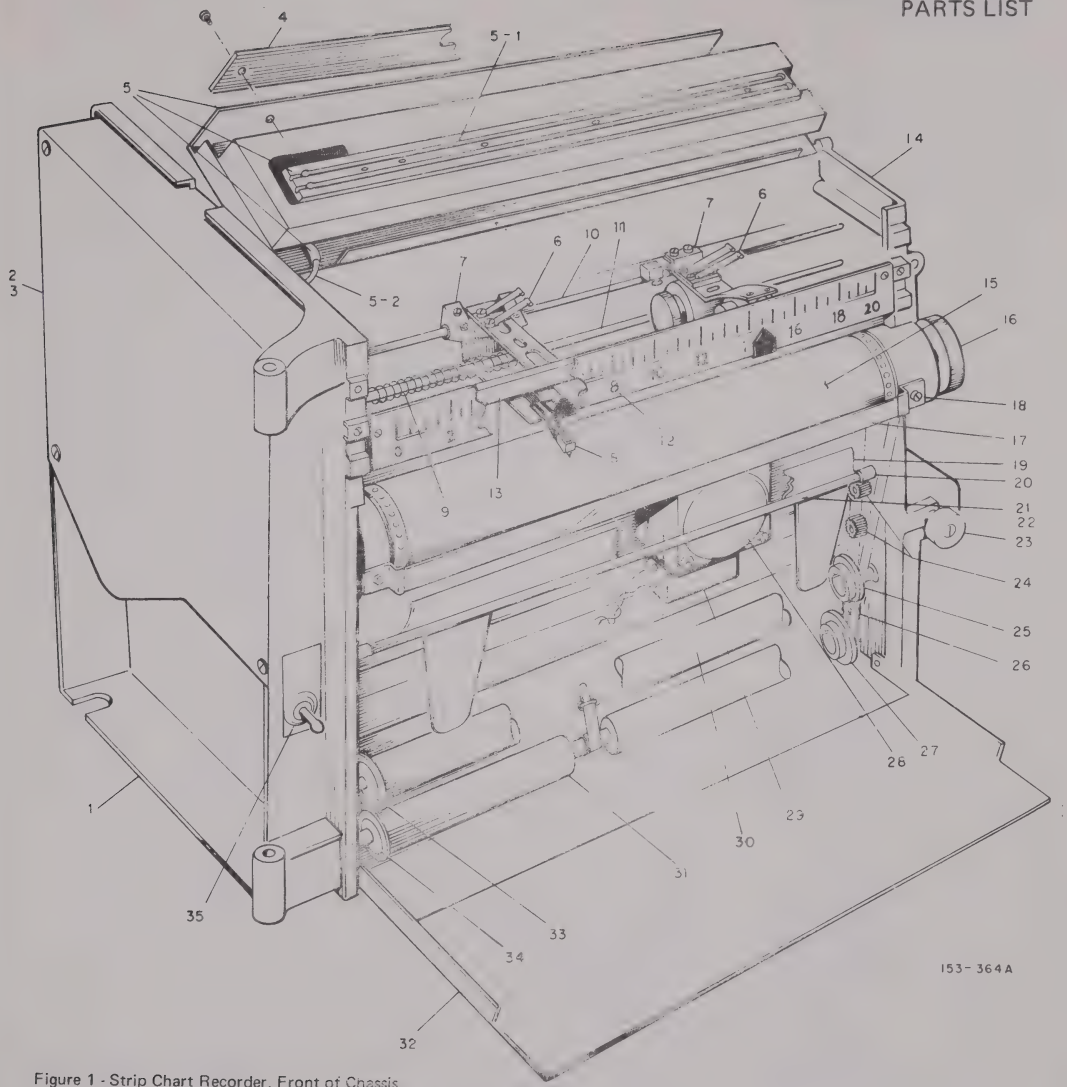


Figure 1 - Strip Chart Recorder, Front of Chassis

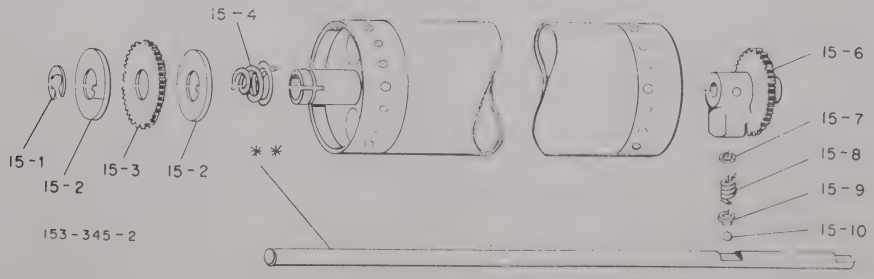


Figure 2, Chart Drum Assembly

ELECTRONIK 153
STRIP CHART RECORDER
FRONT OF CHASSIS
PARTS LIST

Figure and Key No.	Part No.	Description	Recom'd Spare Parts Per 1	Recom'd Spare Parts Per 10	Quantity
1					
1	—	Lh side chassis casting for:			
	30079390-002	1 pen & multipoint			1
	30079390-003	2 pen recorder			1
2	30078947-001	cover for chart drive			1
3	†	chart drive and/or print mechanism			1
4	30078890-000	instrument nameplate (blank)			1
	—	slidewire, cable and housing assy. for:			
5	30366023-003	multipoint & rear of 2 pen recorder	1	2	1
	30366023-010	1 pen recorder	1	2	1
	30366023-017	model 1531685X only	1	2	1
	30366031-000	front of 2 pen recorder (not shown)	1	2	1
	30366753-001	Rh mtg. bracket, front slidewire of 2 pen			1
	30366754-001	Lh mtg. bracket, front slidewire of 2 pen			1
5-1	—	repl. 20 ohm slidewire & form for:			
	30078974-005	1 pen & multipoint			1
	30078974-004	rear of 2 pen (use 30366031 for front of 2 pen)			
5-2	—	slidewire cable for:			
	30365973-001	1 pen, multipoint & rear of 2 pen			1
	30365973-002	front pen of 2 pen recorder			1
	30365973-007	model 1531685X only			1
6	30078973-001	slidewire contactor	2	4	1,2
	30369746-001	slidewire contactor, (1531685X)	2	4	1
7	†	recording carriage assy.			
8	—	pen body assy. for:			
	30682015-501	1 pen recorder	1	2	1
	30366724-001	front pen, 2 pen recorder	1	2	1
	30366723-001	rear pen, 2 pen recorder	1	2	1
9	30366742-001	ink delivery tubing	2	4	1,2
10	30078953-000	carriage guide rod			1,2
11	—	support rod for:			
	30367778-001	1 pen recorder			1
	30078626-000	front pen, 2 pen recorder			1
	30366750-001	rear pen, 2 pen recorder			1
12	—	scale (specify range & actuation) for:			
	30077078-range	multipoint, 1 & 2 pen, single range			1
	30357245-range	1 pen, dual range			1
	30363996-range	2 pen, dual range			1
13	—	channel track for:			
	30078948-000	1 pen, multipoint & rear of 2 pen			1
	30357255-000	front of 2 pen			1
14	—	Rh side chassis casting for:			
	30079380-010	1 pen recorder			1
	30079380-002	multipoint			1
	30079380-003	2 pen recorder			1

† see separate section for detail parts

Figure and Key No.	Part No.	Description	Recom'd Spare Parts Per 1	Per 10	Quantity
15	30362958-002	chart drum assy. (see Figure 2 for detail parts)			1
**	30078950-004	chart drum shaft (not part of this assembly, order separately)			1
15-1	30362960-000	retaining ring for shaft			1
15-2	30078863-002	key washer			1
15-3	30078865-000	gear 60 tooth			1
15-4	30362981-000	spring			
15-5	30362384-000	sprocket and ratchet, 20 tooth			
15-6	30077458-000	washer			
15-7	30362968-000	compression spring			1
15-8	30362969-000	ball seat			
15-9	30355915-001	stainless steel ball			1
16	30072650-000	knob for chart drum			1
17	30367362-000	chart tear off strip			1
18	30367363-000	mtg. bracket			2
	*	mtg. screw 6-32 5/16"			2
19	30078621-003	chart guide assy.			1
20	30078625-000	spacer			2
21	30078624-000	front support rod for chart guide			1
22	30078626-000	rear support rod for chart guide (not shown)			1
23	30078812-000	latch knob & shaft			1
24	30368711-000	latch spring & rod assy.			1
	*	mtg. screw 6-32, 5/16"			2
25	30368710-000	adj. chart guide disc assy.			1
26	30079297-000	reroll chain	1	2	1
27	30078820-000	chart reroll & shaft assy.			1
28	†	servo balancing motor	1	2	1,2
	30355018-008	mtg. screw for 1 pen, multipoint or purple dot motor of 2 pen servo			2
	30355018-011	mtg. screw for red dot motor of 2 pen servo			2
29	30352110-001	motor capacitor & cable assy.			1,2
30	30040618-000	chart supply tube (metal)			1
31	30008574-000	chart roll tube (fibre)			1
	30355556-000	chart saver device (Table VII Option 001)			1
32	30079158-002	chart guide			1
33	30078831-003	chart supply spindle			1
34	30078831-002	chart reroll spindle			1
35	30078887-000	chart drive switch			1

† see separate section for detail parts
*commercially available parts
** see Figure 2

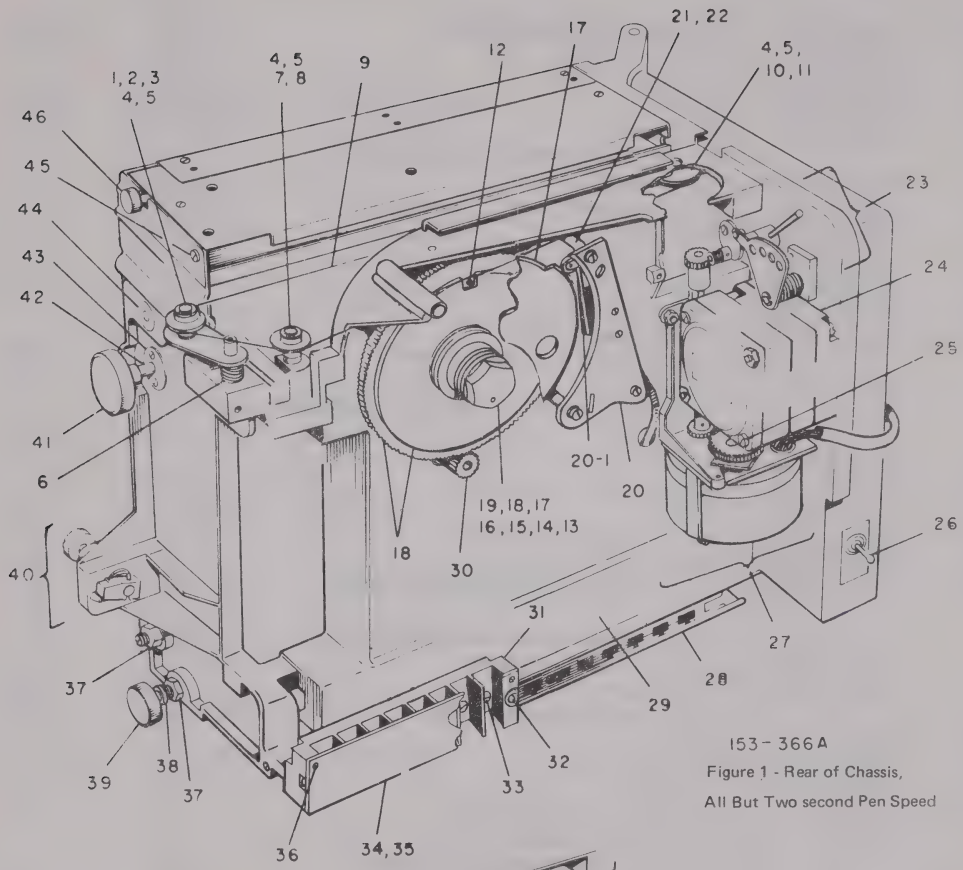


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Figure 1 - Rear of Chassis,
All But Two second Pen Speed

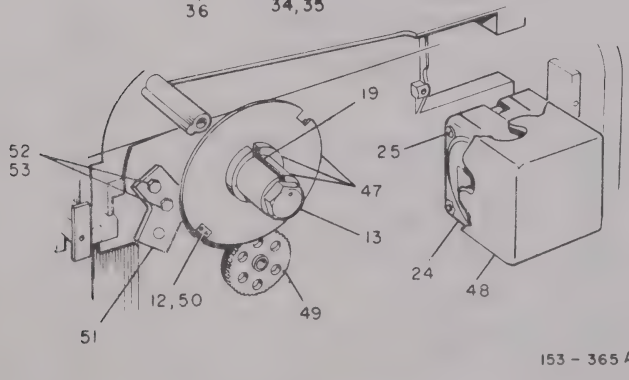

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Figure 2 - Rear of Chassis, Two Second Pen Speed

7

ELECTRONIK 153
ONE PEN & MULTIPOINT RECORDER
REAR OF CHASSIS
PARTS LIST

Key No.	Part No.	Description	Quantity
1	30366012-001	cable take up pulley & stud assy.	1
2	30356403-001	cable take up pulley	1
3	30356398-001	pulley only	1
4	30356397-000	spacer	3
5	30079027-000	hex nut	6
		(items 2 thru 5 are detail parts of Key No. 1	
6	30079170-000	take up spring	1
7	30356404-002	pulley & stud assy.	1
8	30356398-001	pulley only	1
9	30079194-001	servo drive cable	1
10	30356404-003	pulley & stud assy.	1
11	30363679-000	pulley only	1
12	30079196-000	drive cable anchor block	1
	*	mtg. screw 3-037 & lockwasher 79801	2 ea.
13	30078612-001	thrust screw	1
		(items 14, 15, 16 & 17 are used only with desensitizing switch, Key No. 20)	
14	30078021-000	thumb nut	1
15	30078022-000	washer	1
16	30077214-000	spacers	5
17	30361620-000	cam for densensitizing switch	1
18	30076230-002	cable drum & drive bearing	1
19	30352620-000	drive bearing (thru center casting, not shown)	1
	*	mtg. screw 10-32 5/16"	3
20	—	desensitizing switch & cable assy. (optional)	1
	30361614-001	used on 4 1/2 sec. pen speeds	
	30361614-002	used on 2 sec. pen speeds	
	*	mtg. screw 8-012 & lockwasher 914	2 ea.
20-1	30361615-000	switch only	1
21	30074682-004	mtg. spacer	2
22	30004971-000	mtg. washer	2
23	†	multipoint retard cam & rachet, cam follower, worm gear, etc. (see Chart Drive, Print Mechanism & carriage assy. Parts List)	—
24	†	chart drive motor	1
25	30355018-008	mtg. screw	2
26	30078886-000	power on-off switch	1
27	†	multipoint selector switch & or control switch & cable assy & mtg. bracket	1
	*	mtg. screw 10-32, 5/8"	2
	*	mtg. screw 10-32, one inch	1
	*	mtg. lockwasher #925, int. teeth	3
28	30365563-001	cable raceway	1
	*	mtg. screw 8-32, 5/16"	2
29	30365958-006	center chassis casting	1
30	†	balancing motor pinion	1
31	30078397-000	terminal block	1
32	*	mtg. screw 3-139 & lockwasher 925	2 ea.

* commercially available parts
†see separate section for detail parts

Key No.	Part No.	Description	Quantity
33	30357123-001	terminal screw	8
34	30078404-000	terminal block cover	1
35	30078405-004	marker strip	1
36	*	cover mtg. screw 6-32, 1/4"	2
37	30043008-000	locknut	2
38	30078819-000	adjustable bearing	1
39	30078825-000	chart reroll knob	1
40	30078812-000	chassis latch knob & shaft	1
	30362052-000	latch spring	1
	30078787-000	latch pawl	1
	30076123-000	spacer	1
	30075239-002	cotter pin	1
41	30072650-000	knob for chart drum	1
42	30079275-000	bushing	1
43	30078951-000	bearing for chart drum shaft	2
	*	mtg. screw 6-32, 5/16"	2
44	30078871-000	bearing for actuating channel, (multipoint only)	1
45	30079102-000	fulcrum screw	2
46	30078855-001	thumb nut	1
47	30366844-001	cable drum & drive assy.	1
48	30368274-001	motor shield (model 153168X only)	1
49	30366843-001	balancing motor pinion	1
50	30366842-001	spacer for cable anchor block	1
51	30369097-001	stop plate	1
52	30369098-001	stop plate mtg. stud	2
53	30007057-000	collar	2

* commercially available parts

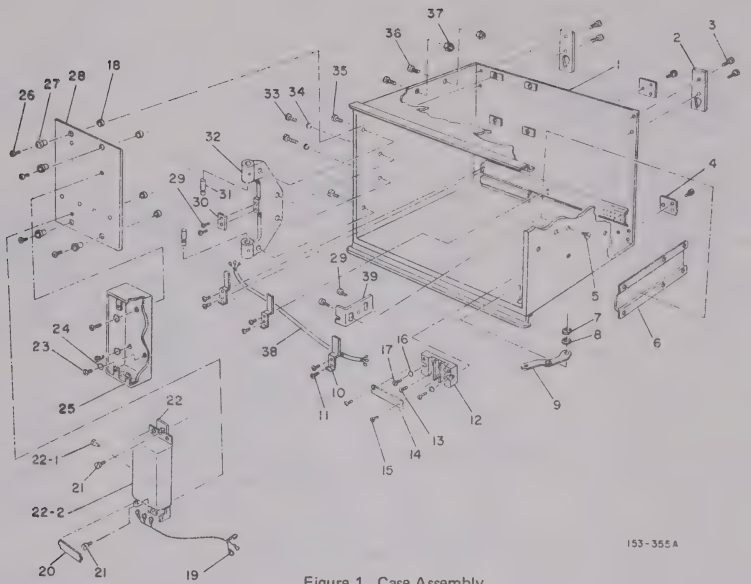

Figure 1. Case Assembly

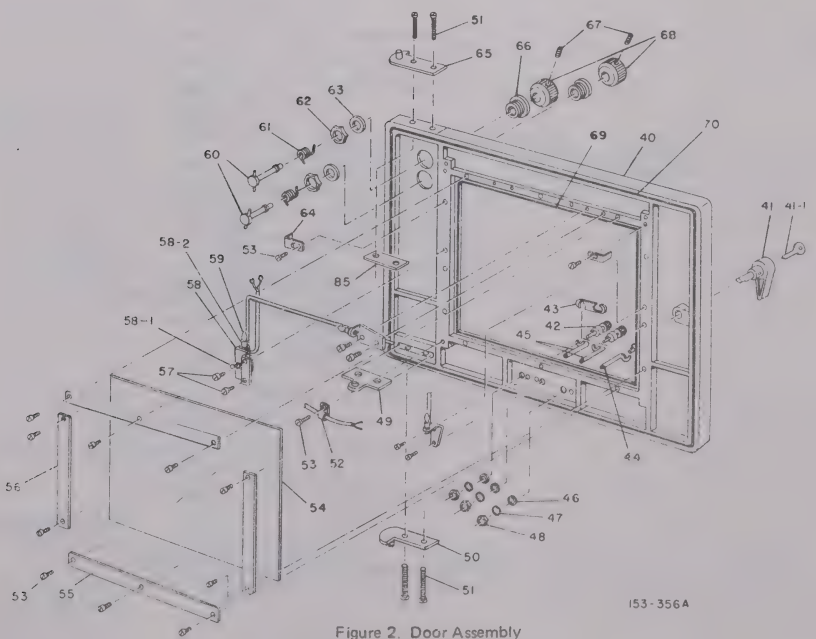

Figure 2. Door Assembly

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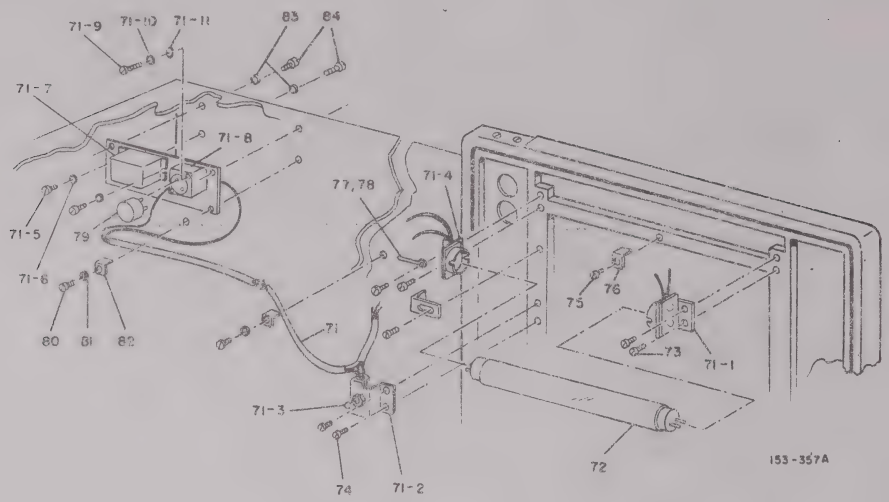

Figure 3. Fluorescent Lighting

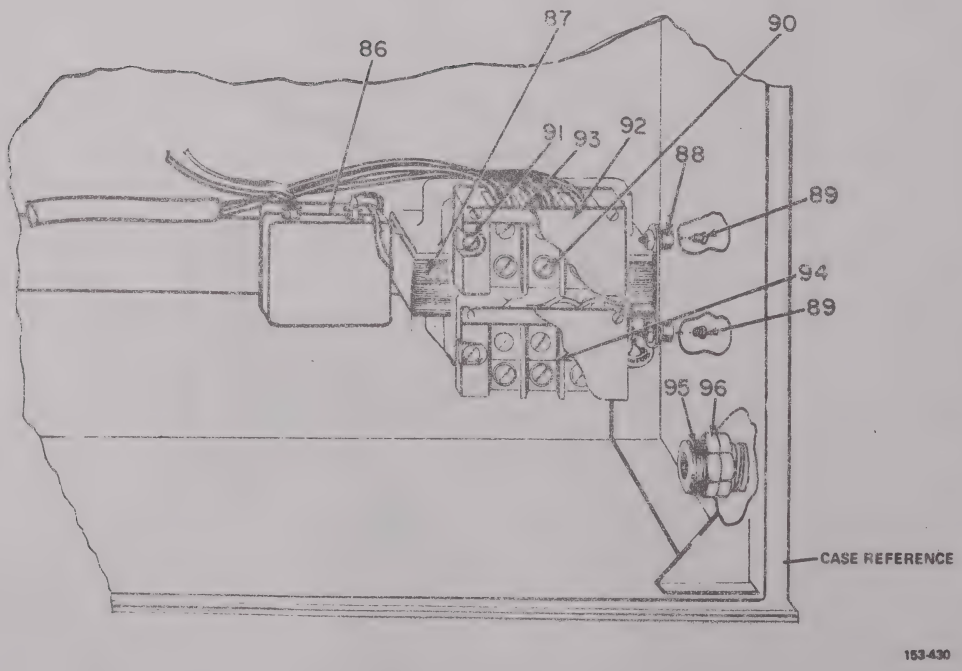

Figure 4. 230 Volt Step Down Transformer

Key No.	Part No.	Description	Recom'd Spare Parts Per 1	Recom'd Spare Parts Per 10	Quantity
1	30359425-010	case - dark beige			1
	30359425-011	case - black			1
2	30079550-000	support, case			2
3	*	screw 1/4–20 Phillips 100° flat head 1/2"			8
4	30079556-000	support, case			2
5	*	screw & lockwasher 8–32 Phillips round head 3/16" (on 240V case)			6
6	30701942-000	tap strip (on 240V case)			1
7	30040283-000	external cotter			1
8	30076445-000	washer, plain .285 ID. x 1/2 OD. x .0320 THK			1
9	30076462-000	door stop link assembly			1
10	30079551-000	cable clamp			3
11	*	screw & lockwasher 10–32 Phillips round head 1/4"			6
12	30078406-000	terminal block			1
13	*	screw & lockwasher 8–32 Phillips round head 1/4"			3
14	3078403-007	marker strip			1
15	*	screw 6–32 Phillips pan head 1/4"			2
16	*	lockwasher # 10 plain .040 thick			2
17	*	screw 10–32 Phillips pan head 3/4"			2
18	30365942-001	bushing			4
19	30365989-110	cable - 3 wire			1
20	30369770-001	cover			1
21	*	screw 6–32 Phillips pan head 3/16"			2
22	30365389-ITEM	constant voltage unit (see Table 1)	0	1	1
22-1	*	screw # 6 self tap sheet metal 3/16" .			1
22-2	30369769-001	cover 1.47" high			1
	30369769-002	cover, 2.03" high			1
23	*	screw, self tapping # 10/16 binding head 1/4"			3
24	*	lockwasher # 10 external teeth			3
25	30365911-001	case, sub-assembly, measuring circuit single range			1
	30365911-005	case, sub-assembly, measuring circuit, double range			1
26	*	screw 10–32 Phillips round head 7/16"			4
27	30365941-001	bushing			4
28	30365944-001	mounting plate C.V.U.			1
29	*	screw 10–32 Phillips, pan head 5/16"			4
30	30076027-000	lock plate			1
31	30079109-000	hinge pin			2
32	30078893-001	hinge bracket-light beige			1
	30078893-002	hinge bracket-unfinished			1
33	*	screw 1/4–20 Phillips round head 3/4"			2
34	*	lockwasher 1/4" internal teeth			2

*commercially available parts

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Key No.	Part No.	Description	Recom'd Spare Parts Per 1	Recom'd Spare Parts Per 10	Quantity
35	*	screw 1/4–20 Phillips 100° flat head 3/4"			2
36	*	screw & lockwasher 3–48 Phillips round head 3/4"			2
37	*	nut 3–48 hex			2
38	30078888-007	power cable & toggle switch ass'y 44" long			1
	30078888-008	power cable & toggle switch ass'y 54" long			1
39	30077587-000	bracket			1
40	See Table 2	replacement door			1
41	30353172-001	S.R. lock assembly (dark beige)			1
	30353172-004	S.R. lock assembly (black)			1
41-1	30040039-000	key			1
42	30078510-000	binding post, insulated, checking terminal			3
43	30078796-000	connector, checking terminal			1
44	30078509-001	terminal clip, copper strip			varies
	30078509-004	terminal clip, driver harris # 11 alloy			1
	30078509-005	terminal clip, constantan strip			1
45	30078509-002	terminal clip, steel strip			2
46	*	washer, plain .159 ID x 7/16 OD x .0299 THK			3
47	*	lockwasher # 6 internal teeth			3
48	*	nut, hex 6–32			3
49	30362318-000	stop plate & pin assembly			1
50	30362314-002	hinge plate (dark beige)			1
	30362314-004	hinge plate (black)			1
51	*	screw 6–32 flat head 1"			4
52	30040456-000	clamp			1
53	*	screw 6–20 self tapping slotted hex head 5/16"			13
54	see Table 2	window			1
55	30362597-000	retaining strip			2
56	30362598-000	retaining strip			2
57	*	screw 6–32 self tapping flat head 5/16"			6
58	30362752-001	cable & switch assembly 25 3/4" long single pen & multipoint models			1
	30362752-002	cable & switch assembly 47 3/4" long, 2 pen & function plotter models			1
58-1	30077254-000	toggle switch			1
58-2	30071995-000	socket			3
59	30017789-000	lamp	1	3	3
60	30352589-000	shaft			2
61	30074253-000	spring			2
62	*	nut, hex 1/2–20 x 1/8" THK			2
63	*	washer plain 33/64" OD. x 7/8" ID x .0318 THK			2
64	30362749-000	clamp			2
65	30362314-001	hinge plate (dark beige)			1
	30362314-003	hinge plate (black)			1
66	30074256-000	bushing			2

*commercially available parts

Figure and Key No.	Part No.	Description	Recom'd Spare Parts Per 1	Recom'd Spare Parts Per 10	Quantity
67	*	set screw 8–32 socket 1/4"			2
68	30074203-000	knob			2
69	B-1185-000	gasket, glass 3/32 O.D. x 1/32 wall x 45" long	1	2	1
70	30074029-004	gasket, door	1	2	1
71	30357478-001	fluorescent light cable ass'y 60 Hz			1
	30357478-002	fluorescent light cable ass'y 50 Hz			1
71-1	30357479-000	lamp socket - latch side of door			1
71-2	30079846-000	bracket			1
71-3	30077254-000	toggle switch			1
71-4	30357482-000	lamp socket - hinge side of door			1
71-5	*	screw 8–32 fillister head 3/16"			2
71-6	*	lockwasher #8 internal teeth			2
71-7	30362212-002	ballast – 50 Hz			1
	30362212-003	ballast – 60 Hz			1
71-8	30357488-000	socket for starter			1
71-9	*	lockwasher #6 plain			2
71-10	*	washer #6 plain			2
71-11	*	screw 6–32 fillister head 3/4"			2
72	30357485-002	fluorescent lamp cool white 8 watts	1	2	1
73	*	screw #6 self tap slotted hex head 5/16"			4
74	*	screw 6–32 self tap flat head 5/16"			2
75	*	screw #6 self tap slotted hex head 3/8"			2
76	30362749-000	clamp			2
77	30353320-000	solder lug			1
78	30352274-003	tubing, varnished #18 x 7/8" long			1
79	30357489-000	starter, fluorescent light	1	2	1
80	*	screw 8–32 fillister head 3/16"			2
81	*	lockwasher #8 external teeth			2
82	30079052-000	cable clamp			2
83	*	lockwasher #6 plain			3
84	*	screw 6–32 binding head 3/8"			3
85	30362315-000	upper stip plate			1
86	30075630-002	capacitor - 2 MFD			2
	30000008-020	screw for mtg. capacitor flst. hd. 10-32, 1-1/4"			2
	30000925-000	lockwasher			2
87	30353669-000	transformer 230 Volt operation			1
88	30356913-003	spacing nut			2
89	30000061-804	screw			4
90	30078406-000	terminal block 3 pt.			1

*commercially available parts

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ELECTRONIK 153 POTENTIOMETER
STRIP CHART RECORDER
CASE AND DOOR
PARTS LIST

Key No.	Part No.	Description	Recom'd Spare Parts Per 1 10	Quantity
91	30365238-001	mtg. stud		2
92	30078402-000	cover for block		1
93	30078403-011	marker strip		1
94	30078406-000	terminal block 3 pt. used only when toggle switch omitted		1
95	30005416-002	air purge nipple (Table VII Option 64)		1
96	30005262-001	lock nut		2
	30006471-000	washer		2

TABLE 1
CONSTANT VOLTAGE UNIT

	30365389—						
	501	502	503	504	505	506	509
30369769-001 cover 1.47" HIGH 30369769-002 cover 2.03" HIGH	1	1	1	1	1	1	1
T/C & MV Actuations, Spans to 100 MV, 115V, 50/60 Hz	1						
T/C & MV Actuations, Spans Over 100 MV, 115V, 50/60 Hz		1					
T/C Actuation with Resistor Burnout, 115V, 50/60 Hz			1				
T/C & MV Actuation, Spans to 100 MV, 120V, 25 Hz				1			
T/C & MV Actuation, Spans Over 100 MV, 120V, 25 Hz					1		
T/C Actuation, Spans to 120V, 25 Hz						1	
Resistance Bulb Actuation 115V, 50/60 Hz							1

TABLE 2
REPLACEMENT DOOR ASSEMBLIES

DOOR PLAIN OR ILLUMINATED		DESCRIPTION	WINDOW		CHECKING	EXTERNAL CONTROL
BEIGE	BLACK		PART NO.	COMPOSITION	TERMINALS	KNOBS
30363413-001	30363413 101	Standard Door	30079544-000	Glass	Without	Without
30363413-002	30363413-202	Moist -O-Graph (same as —001 or —101 except for M-O-G Decal)	30079544-000	Glass	Without	Without
30363413-003	30363413-103	Standard Door	30079544-000	Glass	Upper	Without
30363413-004	30363413-104	Standard Door	30079544-000	Glass	Without	Lower
30363413-005	30363413-105	Standard Door	30079544-000	Glass	Upper	Lower
30363413-006	30363413-106	Standard Door	30079544-000	Glass	Without	Upper
30363413-007	30363413-107	Standard Door	30079544-000	Glass	With	Upper
30363413-008	30363413-108	Standard Door - Dual Index	30079544-000	Glass	Without	Upper & Lower
30363413-009	30363413-109	Standard Door - Dual Index	30079544-000	Glass	With	Upper & Lower
30363413-010	30363413-110	Standard Door	30700418-000	Anti-Glare Glass	Without	Without
30363413-011	30363413-111	Standard Door	30700011-000	Plexiglass	Without	Without
30363413-012	30363413-113	Standard Door	30650713-001	Laminated Safty Glass	Without	Without
30678773-001	30678773-002	Standard Door with Lock Ass'y.	30079544-000	Glass	Without	Without

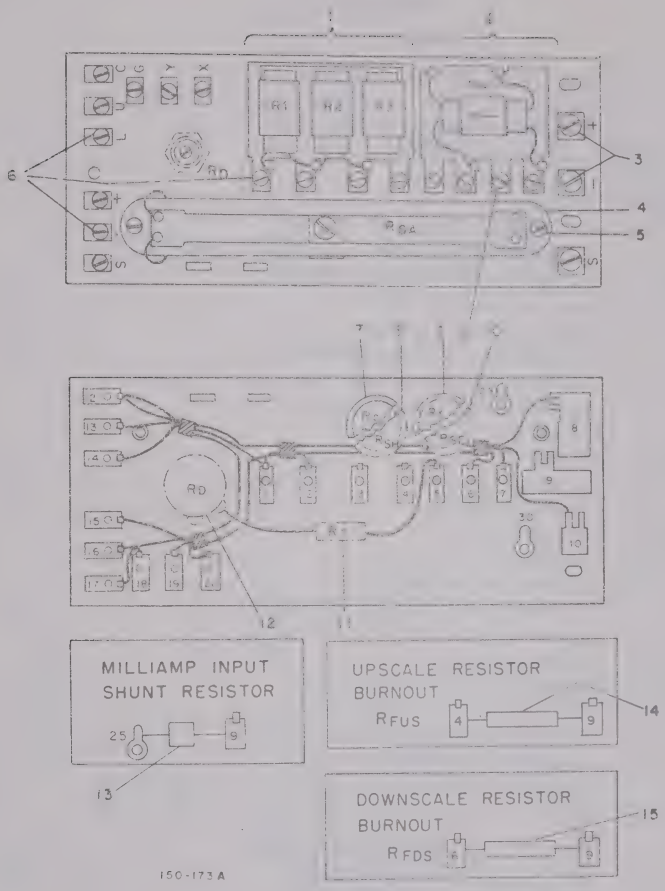

Figure and Key No.	Part No.	Description	Quantity
1			
--	(see below)	Measuring Circuit Unit (MCU)	1
	30682555-001	thermocouple (T/C) or millivolt (MV) input	
	30682555-002	T/C or MV & upscale burnout	
	30682555-003	T/C or MV & downscale burnout	
	30682555-004	T/C or MV, Model 158 only	
	30682555-005	radiamatic, 50 to 110% calibrating pot.	
	30682555-006	radiamatic, 50 to 200% calibrating pot.	
	30682561-001	milliamp (MA) input	
	30366064-002	tachometer or voltage input	
	30366057-010	mixture consistency, (thermal converter)	
1	†30365928-999	quick range change card assy.	1

* commercially available parts

† factory calibrated, supply complete range & actuation when re-ordering.

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ELECTRONIK 15
MEASURING CIRCUIT UNIT (MCU)
FOR QUICK RANGE CHANGING
PARTS LIST

Figure an Key No.	Part No.	Description	Quantity
2	30365927-item	R_{ni} cold junction resistor card assy.	1
	30365927-006	millivolts, MV, Vdc	
	30365927-002	chromel-alumel, K	
	30365927-004	copper-constantan, T	
	30365927-005	noble metals, R, S	
	30365927-008	iron-constantan, J	
3	*	screw 8-32 washer hd. 3/16"	3
4	30363024-001	R_{sa} span adjust resistor (range spans of 2.5 to 40 MV)	1
	30363024-004	R_{sa} span adjust resistor (41 to 63 MV)	1
5	*	screw 4-40 round hd. 1/4"	2
6	*	screw 4-40 binding hd. 5/16"	17
7	†30365924-001	R_c current limiting resistor (509.5Ω)	1
8	†30365924-999-Ω	R_{sh} wire wound shunt resistor, tachometer or Vdc input	1
9	30366058-item	R_x resistor (used on Model 158 only)	1
	30366058-001	MV span 2.5 to 14.9	
	30366058-002	MV span 15 to 24.9	
	30366058-003	MV span 25 to 34.9	
	30366058-004	MV span 35 to 44.9	
	30366058-005	MV span 45 to 110	
10	†30365924-999-Ω	R_{se} series resistor $<$25K	1
	†30700043-999-Ω	R_{se} series resistor $>$25K	1
11	30682642-172	R_y resistor, metal film 1700Ω 1/2W ±1%	1
	30682642-771	R_y resistor, metal film 770Ω 1/2W ± 1%, radiamatic input	1
12	30687652-005	R_d variable resistor, radiamatic input	1
13	30366950-001	2.5Ω shunt resistor, milliamp (MA)	1
14	*	R_{fus} resistor, composition 1/2W, ± 10% span $<$ 10MV, use 56 meg span $<$ 40MV, use 15 meg span $<$ 120MV, use 4.7 meg	1
15	*	R_{fds} resistor, composition 1/2W ± 10% span $<$ 10MV & R1 $<$ 10Ω use 150K span $<$ 40MV & R1 $<$ 10Ω use 82K span $<$ 120MV & R1 $<$ 10Ω use 68K span $<$ 10MV & R1 $<$ 4Ω use 330K span $<$ 40MV & R1 $<$ 4Ω use 150K span $<$ 120MV & R1 $<$ 4Ω use 82K span $<$ 10MV & R1 $<$ 13Ω use 1200K span $<$ 40MV & R1 $<$ 13Ω use 330K span $<$ 120MV & R1 $<$ 13 Ω use 150Ω	1

* commercially available parts.
† factory calibrated, supply complete range & actuation when re-ordering.

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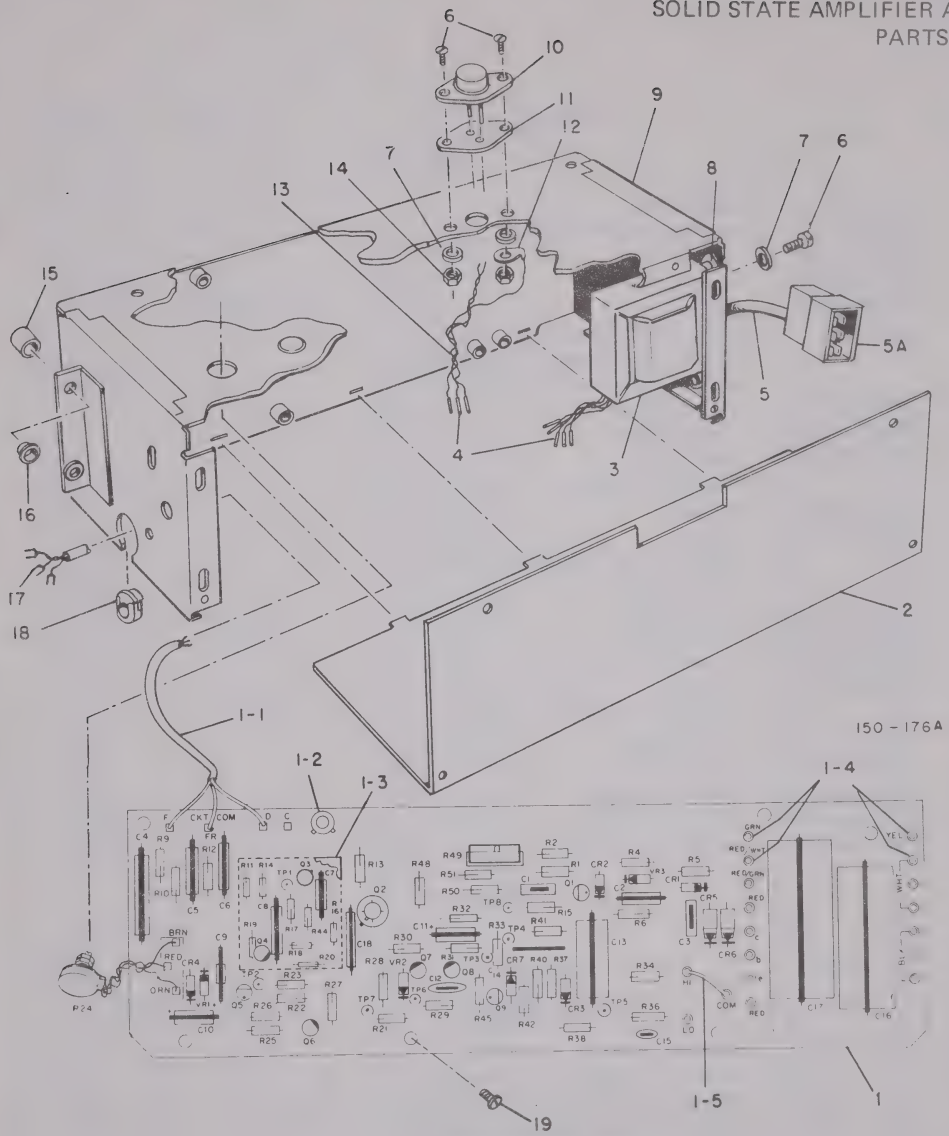

Fig. 1 - Solid State Amplifier Assy.

TABLE 1

Amplifier Assy. 30682531-item	Amp. Circuit Board Key 1	Power Cable Key 5	Type Connector	Male Connector Key 5A	Female Connector (not shown)	Input Cable Key 1-1	Cable Length
-501	30679349-001	30682544-001	plastic	30365401-001	30365401-002	30682543-004	14"
-503	30679349-001	30682544-001	plastic	30365401-001	30365401-002	30682543-002	26"
-701	30679349-002	30682544-002	Jones	30353763-001	30353763-002	30682543-004	14"
-703	30679349-002	30682544-002	Jones	30353763-001	30353763-002	30682543-002	26"
-101	30679349-003	30674235-001	none	none	none	30682543-003	32"

ELECTRONIK 15
SOLID STATE AMPLIFIER ASSY.
PARTS LIST

Figure and Key No.	Part No.	Description	Quantity
1			
—	see Table 1	amplifier assy.	1
1	see Table 1	amplifier circuit board assy.	1
2	30679831-001	amplifier cover	1
3	30679828-001	transformer assy.	1
4	30369283-001	connectors	as Req'd
5	see Table 1	power cable & connector	1
5A	see Table 1	male & female, Jones or plastic connectors	1 ea.
6	*	screw 6-32 binding hd. 5/16"	4
7	30373316-001	insulating washer	4
8	30679829-001	interior insulator	1
9	30679833-001	amplifier case	1
10	*	transistor RCA 37835	1
11	30677675-001	insulator	1
12	30351944-000	terminal	1
13	*	stranded 22 Ga. wires, 4" length	3
14	*	hex nut # 6-32	2
15	30365942-002	female insulator	4
16	30365941-002	male insulator	4
17	30365972-001	terminal connectors	3
18	30369824-002	grommet	2
19	*	mtg. screw 4-40 binding hd. 1/4"	7
1-1	see Table 1	input cable assy.	1
1-2	30689897-001	terminal lug	1
1-3	30374468-001	metal can (shield)	1
1-4	30371395-012	male pin connectors	as Req'd
1-5	30724535-903	jumper wire & terminal connector	1

Key No.	Part No.	Description				Quantity
		Fixed Capacitors	μf	WVDC	Tol.±	
C1, C3	*	metallized plastic	0.1	200	20	2
C2, C10	*	electrolytic, tantalum	6.8	35	10	2
C4	*	electrolytic, tantalum NP	2.3	20	10	1
C5, C8	*	electrolytic, alum. oxide NP	1.1	60	10	2
C6, C18	*	electrolytic, alum. oxide NP	0.5	60	10	2
C7	*	metallized plastic	0.01	100	20	1
C9, C14	*	electrolytic, tantalum	1.0	20	20	2
C11	*	electrolytic, tantalum	10	10	20	1
C12	*	ceramic dielectric	0.01	500	20	1
C13	*	electrolytic, alum. oxide	100	25	+100-10	1
C15	*	ceramic dielectric	0.001	25	—	1
C16	*	metallized plastic	1.0	330AC	20	1
C17	*	electrolytic, alum. oxide NP	130	15AC	+50-10	1

*commercially available parts

Key No.	Part No.	Description	Ohms	Watt	Tol.	Quantity
CR1, CR2 CR3, CR4 CR7	*	diode 1N459				5
CR5, CR6	*	diode 1N2069				2
Q1,Q5,Q9	*	transistor 2N3702				3
Q2	30676604-001	transistor				1
Q3	*	transistor D4470-3				1
Q4	*	transistor 2N3906				1
Q6,Q7,Q8	*	transistor 2N3391A				3
		Resistor				
R1	*	fixed composition	27K	1/2	10	1
R2	*	fixed composition	5.6K	1/2	10	1
R4, R10	*	fixed composition	22K	1/2	5	2
R5	*	fixed composition	2.2K	1/2	10	1
R6, R41	*	fixed composition	56 Ω	1/2	10	2
R9	*	fixed composition	12K	1/2	10	1
R11, R16	*	fixed composition	10M	1/4	5	2
R12	*	fixed composition	56K	1/2	5	1
R13,R22	*	fixed composition	15K	1/2	10	2
R14	*	fixed composition	100K	1/4	5	1
R15	*	fixed composition	1M	1/2	10	1
R17	*	fixed metal film	10K	1/4	1.0	11
R18	*	fixed composition	390K	1/4	10	1
R19	*	fixed composition	2.2K	1/4	10	1
R20	*	fixed composition	180K	1/4	10	1
R21,R42	*	fixed composition	820Ω	1/4	10	2
R23,R31	*	fixed composition	220K	1/2	10	2
R24	*	variable, taper Z, Clarostat, series 47	5K	–	10	1
R25,R37,R45	*	fixed composition	10K	1/2	10	3
R26	*	fixed composition	33K	1/2	10	1
R27	*	fixed composition	100Ω	1/2	10	1
R28,R29,R36	*	fixed composition	100K	1/2	10	3
R30	*	fixed composition	82K	1/2	10	1
R32	*	fixed composition	1K	1/2	10	1
R33	*	fixed composition	68K	1/2	10	1
R34	*	fixed composition	560K	1/2	10	1
R38	*	fixed composition	330K	1/2	10	1
R40	*	fixed composition	18K	1/2	1	1
R44	*	fixed metal film	1K	1/4	1	1
R48,R50	*	fixed metal film	1M	1/4	1	2
R49	*	variable, comp. linear	50K	1/8	1	1
R51	*	fixed metal film	7.68K	1/4	1	1
VR1	30369764-036	zener diode				1
VR2, VR3	30369764-021	zener diode				2

* commercially available parts

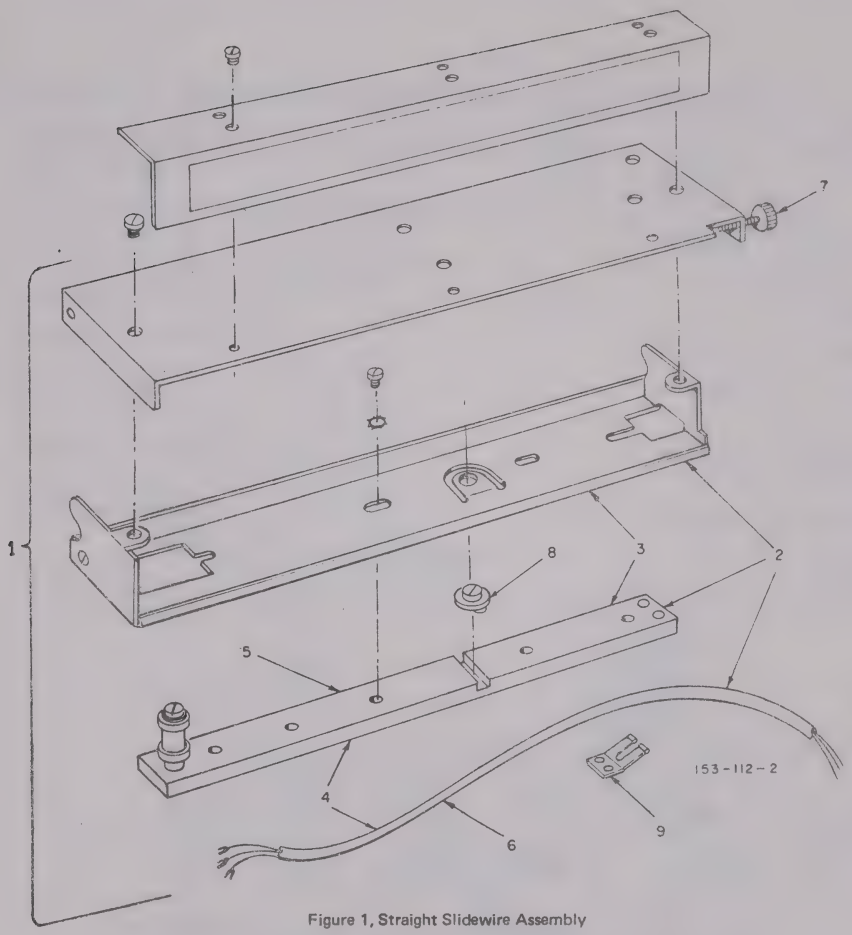

Figure 1, Straight Slidewire Assembly

Key No.	Part No.	Description	Quantity
1	30366023-item	slidewire form, cable, mtg. bracket & housing, see table 1	1
2	30366031-001	slidewire form, cable & mtg. bracket, see table 1	1
3	30702378-001	slidewire form & mtg. bracket, see table 1	1
4	30362064-item	slidewire form & cable, see table 1	1
5	30078974-item	slidewire form only, see table 1	1
6	30365973-item	cable only	1
7	30078855-001	thumb nut on housing	1
8	30078984-000	eccentric	as req'd
9	see table 2	contactor	1

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TABLE 1

Straight Slidewire & Component Parts, Available in the Following Levels of Assembly

20Ω slidewire used on:	Key No. 1 S/W, cable, bracket & housing	Key No. 2 S/W cable & bracket	Key No. 3 S/W & brkt.	Key. No. 4 S/W & cable	Key No. 5 S/W only	Key No. 6 cable
Multipoint & 2 Pen Recorder (rear S/W)	366023-003	–	–	–	78974-004	365973-001
2 Pen (front S/W)	–	366031-001	–	–	–	365973-002
1 Pen Recorder	366023-010	–	–	–	78974-005	365973-001
Dual Range, Multipoint	366023-011	–	–	–	–	368911-001
Extended Range & Function Plotter	366023-003	–	–	–	78974-004	365973-001
Model 151685X	366023-017	–	–	–	78974-005	365973-007
300 Ω Slidewire, ¼ Sec. Recorder	–	–	702378-001	362064-002	–	–

TABLE 2

Slidewire Contactors

Type of Instrument	Key No. 9 Contactor	† Color Code	Contact Metal	Slidewire Resistance
Single Pen, Multipoint & 2 Pen (rear S/W)	78973-001 78973-002	black white	silver paliney	<100 Ω >100 Ω
2 Pen (front S/W)	78973-003 702418-001	red none	silver paliney	<100 Ω >100 Ω
Model 1531685X, 1/4 or 1/2 Sec. Recorders	369746-001 362083-001	none none	silver ney-oro-g	<100 Ω >100 Ω

† On contactors with no color code: the silver contact will appear dull and the paliney contact will be bright like stainless steel.

MOTORS (USED WITH TRANSISTORIZED AMPLIFIERS) PARTS LIST

MOTORS (used with transistorized amplifiers)

Motor part numbers depend upon motor speed; to order parts for your specific motor, see the following:

For service replacement motor assembly	see table 1
For gear assemblies for motors	see table 2
For components parts for motors	see table 3
For tool kit and components	see table 4

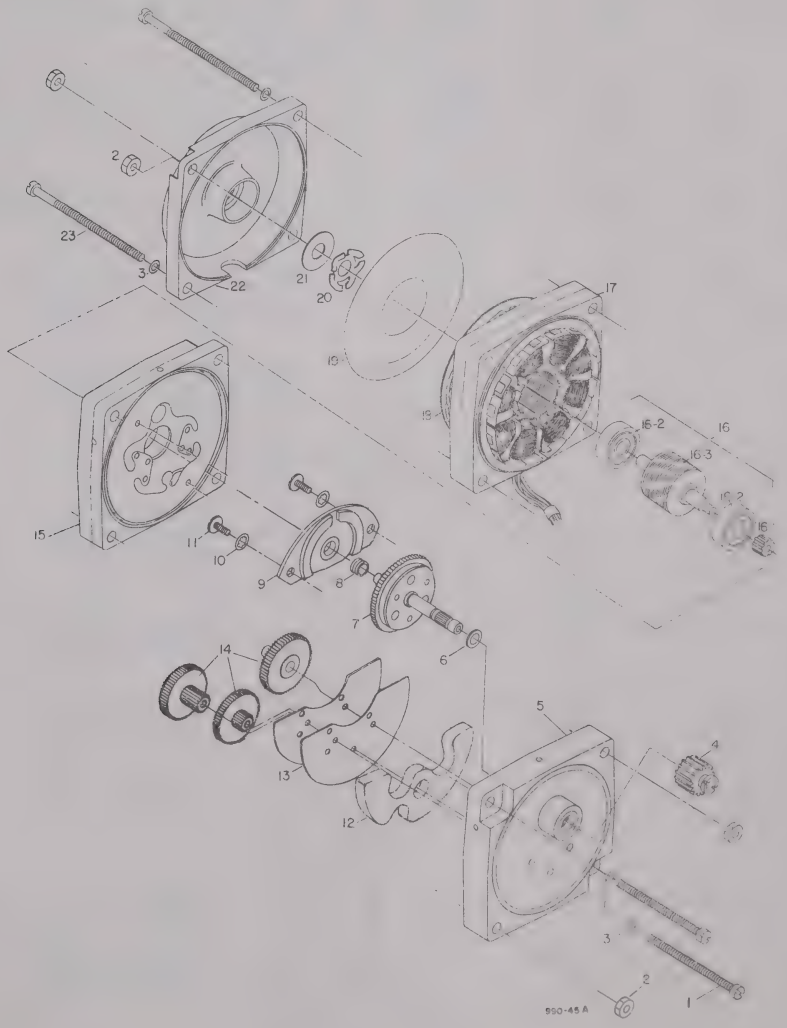

Figure 1. Motor Assembly.

TABLE 1

Service Replacement Part Number	Gear Ratio	120 Volts Frequency (c.p.s.)	R.P.M.	Used ON
365754-501	60:1	50-60	23	Cl. 17 - 5 sec.
-503	10:1	50-60	144	Cl. 18 - 5 sec.
-504	30:1	50-60	48	Cl. 18 - 15 sec.
-505	10:1	50-60	144	Cl. 18 - 1 sec.
-506	10:1	50-60	144	Cl. 15 - 4 1/2 sec.
-507	30:1	50-60	48	Cl. 15 - 12 sec.
-508	60:1	50-60	23	Cl. 15 - 24 sec.
-509	4.4:1	50-60	330	Cl. 15 - 2 sec.
-510	10:1	50-60	144	Cl. 16 - 3 & 5 sec.
-511	30:1	50-60	48	Cl. 16 - 15 sec.
-512	10:1	50-60	144	Cl. 15 - 1 sec.

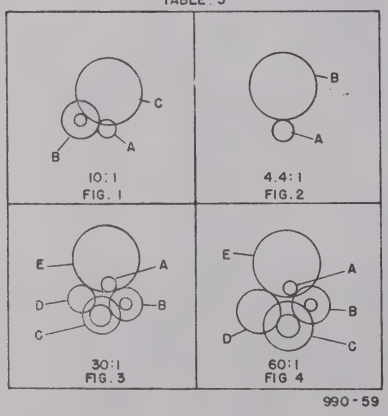

Figure 2. Gear Ratio.

TABLE 2 - GEAR ASSEMBLIES

RATIO	365754 ITEM
10:1	
A	362442 (15T)
B	369844-1 (35T & 14T)
C	353213 (60T)
4.4:1	
A	362440-2 (10T)
B	362448 (44T)
30:1	
A	362441 (11T)
B	369847-1 (42T & 12T)
C	364784 (44T & 28T)
D	364838-1 (28T)
E	353213 (60T)
60:1	
A	362441 (11T)
B	369847-1 (42T & 12T)
C	364786 (44T & 14T)
D	364838-2 (46T)
E	353213 (60T)

MOTORS (USED WITH TRANSISTORIZED AMPLIFIERS)

PARTS LIST

TABLE 3

KEY NO.	PART NO.	DESCRIPTION	SERVICE REPLACEMENT PART NUMBER 365754 - ITEM									
			501	503	504	505	506	507	508	509	510	511	512
1	355018-12	Screw (2)	X	X	X	X	X	X	X	X	X	X	X
2	5966	Nut (4)	X	X	X	X	X	X	X	X	X	X	X
3	925	Lockwasher (4)	X	X	X	X	X	X	X	X	X	X	X
4	362423	Pinion	-	-	-	-	X	X	X	X	-	-	-
4	371299-1	Pinion	-	X	X	-	-	-	-	-	-	-	-
5	365537-1	Gear Housing	-	-	-	-	-	-	-	X	-	-	-
5	365537-2	Gear Housing	-	X	-	X	X	-	-	-	X	-	X
5	365537-5	Gear Housing	-	-	X	-	-	X	-	-	-	X	-
5	365537-6	Gear Housing	X	-	-	-	-	-	X	-	-	-	-
6	362426	Spacer	X	X	X	X	X	X	X	X	X	X	X
7	365539-1	Output Shaft Assembly	-	X	X	-	X	X	X	-	-	-	-
7	365539-3	Output Shaft Assembly	X	-	-	X	-	-	-	-	X	X	X
7	365543-1	Output Shaft Assembly	-	-	-	-	-	-	-	X	-	-	-
8	362478-2	Spacer	X	X	X	X	X	X	X	-	X	X	X
8	71958	Spacer	-	-	-	-	-	-	-	X	-	-	-
9	362410-1	Bearing Plate	X	X	X	X	X	X	X	-	X	X	X
9	362410-2	Bearing Plate	-	-	-	-	-	-	-	X	-	-	-
11	79065-3	Screw (2)	X	X	X	X	X	X	X	X	X	X	X
12	362486	Oil Wick	X	X	X	X	X	X	X	-	X	X	X
13	362487-1	Wick Retainer (2)	X	X	X	X	X	X	X	-	X	X	X
14	-	Gear Assemblies (See Table 3)											
15	365542	Housing & Wick Assembly	X	X	X	X	X	X	X	X	X	X	X
16	362416-501	Rotor Shaft Assembly	-	X	-	X	X	-	-	-	X	-	X
16	362416-502	Rotor Shaft Assembly	-	-	X	-	-	X	X	-	-	X	-
16	362416-504	Rotor Shaft Assembly	-	-	-	-	-	-	-	X	-	-	-
16	362416-505	Rotor Shaft Assembly	X	-	-	-	-	-	-	-	-	-	-
16-1	362442	Pinion	-	X	-	X	X	-	-	-	X	-	X
16-1	362441	Pinion	X	-	X	-	-	X	X	-	-	X	-
16-1	362440-2	Pinion	-	-	-	-	-	-	-	X	-	-	-
16-2	362493	Ball Bearing (2)	X	X	X	X	X	X	X	X	X	X	X
16-3	362417-1	Armature	-	X	X	X	X	X	X	X	X	X	X
16-3	362417-3	Armature	X	-	-	-	-	-	-	-	-	-	-
*17	365458-11	Stator & Cable Assembly	X	-	-	-	-	-	-	-	-	-	-
*17	365458-12	Stator & Cable Assembly	-	X	X	X	-	-	-	-	-	-	-
*17	365458-13	Stator & Cable Assembly	-	-	-	-	X	X	X	-	-	-	X
*17	365458-14	Stator & Cable Assembly	-	-	-	-	-	-	-	X	-	-	-
*17	365458-15	Stator & Cable Assembly	-	-	-	-	-	-	-	-	X	X	-
18	362475	Printed Circuit Plate	X	X	X	X	X	X	X	X	X	X	X
19	362628	Insulator	X	X	X	X	X	X	X	X	X	X	X
20	362398	Spring	X	X	X	X	X	X	X	X	X	X	X
21	362455-1	Washer (as req'd)	X	X	X	X	X	X	X	X	X	X	X
22	362415	Housing	X	X	X	X	X	X	X	X	X	X	X
23	355018-8	Screw (2)	X	X	X	X	X	X	X	X	X	X	X

* Not yet available as an assembly as listed.

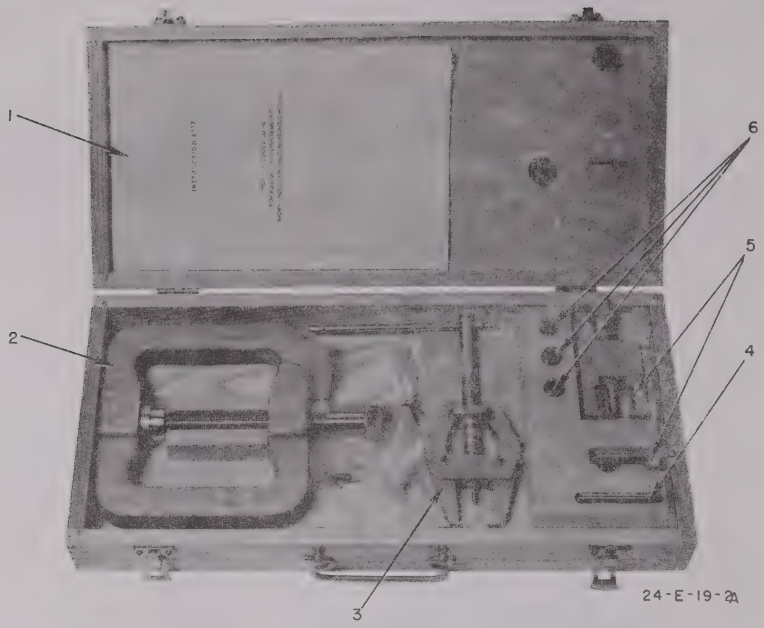

Figure 3. Tool Kit and Components.

TABLE 4

KEY * NO.	DESCRIPTION	HONEYWELL PART NO.	QTY.
	complete tool kit	364950	1
1	case	365568-1	1
2	screw press	365535	1
3	puller for armature pinion and bearing	364402	1
4	pilot for inserting shaft post grease seal in gear housing	364399	1
5	puller for output pinion	364407	1
6	spacer for output shaft 362429	364397-1	1
	spacer for output shaft 362430	364397-2	1
	spacer for output shaft 362458	364397-3	1

REPLACEMENT TIPS		
Description	Part No.	Qty.
puller & press	678759-1	1
puller	678759-2	1
press	678759-3	1

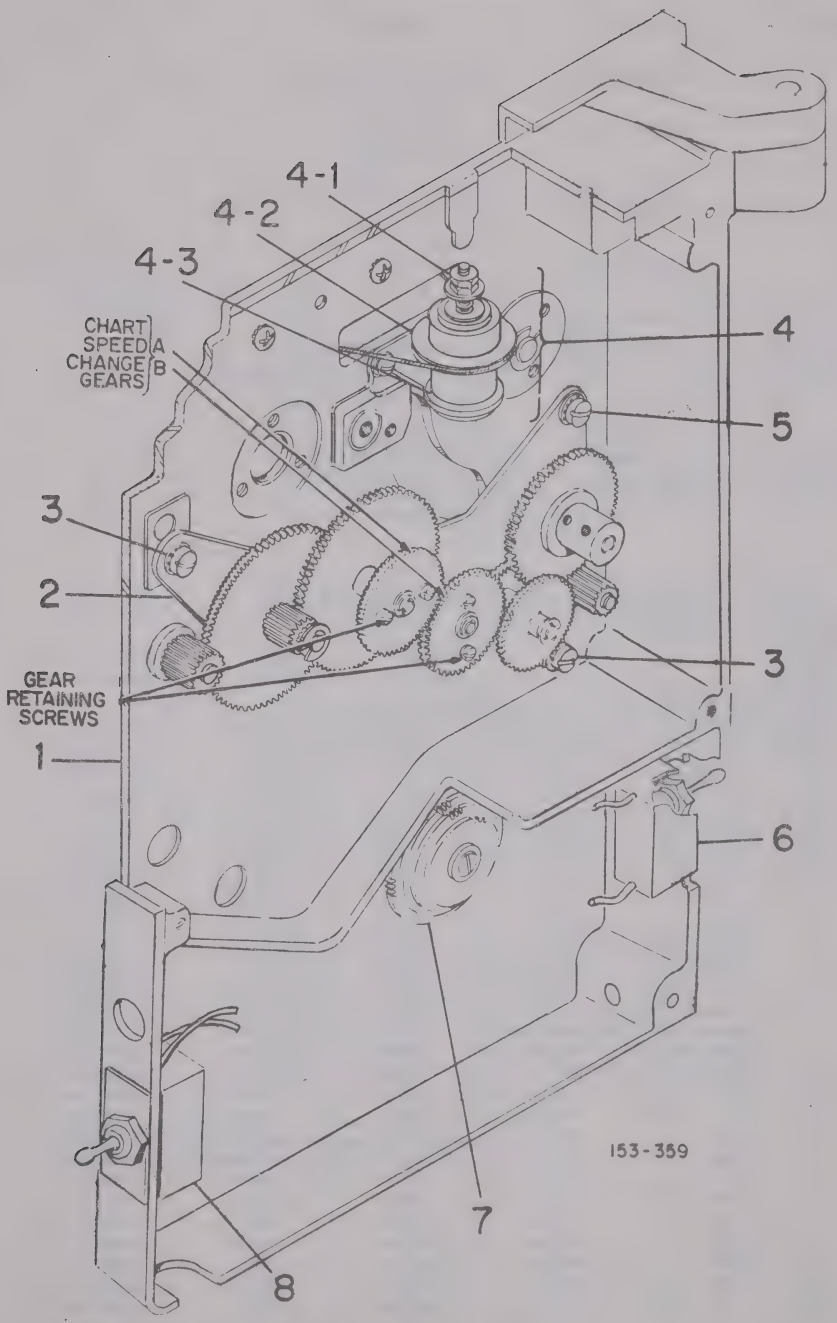

Figure 1. Left Side of Chassis

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ELECTRONIK 15
ONE & TWO-PEN RECORDER
CHART DRIVE MECHANISM
PARTS LIST

Key No.	Part No.	Description	Quantity
1	30365962-006	l.h. chassis side plate assy. (one-pen recorder)	1
	30365969-001	l.h. chassis side plate assy. (two-pen recorder	1
2	see table 1	chart drive mechanism	1
3	30078655-000	dowel screw	2
	*	lockwasher # 10, int. teeth	2
4	30356405-003	pulley & bracket assy.	1
4-1	*	hex nut 5-40	2
4-2	30356398-001	pulley	1
4-3	30351490-000	mtg. bracket & stud assy.	1
5	*	mtg. screw 10-32 fillister head 3/8"	2
	*	lockwasher # 10, int. teeth	2
6	30078887-000	chart drive switch	1
7	see table 3	chart speed change gears	–
8	3007886-000	power on-off switch	1

*commercially available parts

TABLE 1

Chart Drive Mechanisms & Available Chart Speeds

Gear Train 30365241* 30365242 †		30RPM Motor	60RPM Motor	90RPM Motor	180RPM Motor
60 Hz	50 Hz				
*523	*526	1/2"/hr	1"/hr	1 1/2"/hr	3"/hr
*501	*506	1"/hr	2"/hr	3"/hr	6"/hr
*528	–	1 1/3"/hr	2 2/3"/hr	4"/hr	8"/hr
*549	–	1 1/4"/hr	2 1/2"/hr	3 3/4"/hr	7 1/4"/hr
*503	*531	2"/hr	4"/hr	6"/hr	12"/hr
*533	*535	2 1/2"/hr	5"/hr	7 1/2"/hr	15"/hr
*535	*547	3"/hr	6"/hr	9"/hr	18"/hr
*505	*508	5"/hr	10"/hr	15"/hr	30"/hr
*508	–	6"/hr	12"/hr	18"/hr	36"/hr
–	†501	7 1/2"/hr	15"/hr	22 1/2"/hr	45"/hr
†501	–	9"/hr	18"/hr	27"/hr	54"/hr
*538	*539	10"/hr	20"/hr	30"/hr	60"/hr
*539	–	12"/hr	24"/hr	36"/hr	72"/hr
–	*540	12 1/2"/hr	25"/hr	37 1/2"/hr	75"/hr
*540	*541	15"/hr	30"/hr	45"/hr	90"/hr
*541	–	18"/hr	36"/hr	54"/hr	108"/hr
*509	*516	20"/hr	40"/hr	60"/hr	120"/hr
*516	–	24"/hr	48"/hr	72"/hr	144"/hr
*542	–	40"/hr	80"/hr	120"/hr	240"/hr
–	†504	50"/hr	100"/hr	150"/hr	300"/hr
†504	†505	60"/hr	120"/hr	180"/hr	360"/hr
†505	–	72"/hr	144"/hr	216"/hr	432"/hr
–	†507	125"/hr	250"/hr	375"/hr	750"/hr
†507	†508	150"/hr	300"/hr	450"/hr	900"/hr
†508	–	180"/hr	360"/hr	720"/hr	1080"/hr
–	†503	500"/hr	1000"/hr	1500"/hr	3000"/hr
†503	†509	600"/hr	1200"/hr	1800"/hr	3600"/hr
†509	–	720"/hr	1440"/hr	2160"/hr	4320"/hr

Table 2, Chart Drive Mechanism & Gear Sequence

Chart Drive Mechanism 30365241– Item	*Chart Speed In/hr. (30 RPM motor) 60 HZ	50 HZ	Gears & Positions pos. 2	pos. 3	pos. 4	pos. 5	pos. 6	pos. 7	pos. 8
501	1	5/16	30078633	30078636	30078639	30078665	30078667	30078670	30078645
503	2	1 2/3	30078633	30078636	30078639	30078665	30078675	30078678	30078645
505	5	4 1/16	30078663	30078636	30078639	30078665	30078680	30078681	30078645
506	1 1/5	1	30350184	30350185	30078639	30078665	30078667	30078670	30078645
508	6	5	30350184	30350185	30078639	30078665	30078680	30078681	30078645
509	20	16 2/3	30352534	30352536	30078639	30078665	30078680	30078681	30078645
516	24	20	30358955	30358957	30078639	30078665	30359745	30359744	30078645
519	1/3	5/18	30078633	30078636	30078639	30700063	30700066	30078670	30078645
521	2/5	1/3	30350184	30350185	30078639	30700063	30700066	30078670	30078645
523	1/2	5/12	30078633	30078636	30078639	30355561	30078667	30078670	30078645
526	3/5	1/2	30350184	30350185	30078639	30355561	30078667	30078670	30078645
528	1 1/3	1 1/9	30352534	30352536	30078639	30700063	30700066	30078670	30078645
531	2 2/5	2	30350184	30350185	30078639	30078665	30078675	30078678	30078645
533	2 1/2	2 1/12	30078633	30078633	30078639	30355561	30078680	30078681	30078645
535	3	2 1/2	30350184	30350185	30078639	30355561	30078680	30078681	30078645
538	10	8 1/3	30352534	30352536	30078639	30355561	30078680	30078681	30078645
539	12	10	30358955	30358957	30078639	30355561	30359745	30359744	30078645
540	15	12 1/2	30702478-1	30702476-1	30078639	30355561	30078680	30078681	30078645
541	18	15	30702478-1	30702476-1	30078639	30355561	30702480-1	30702482-1	30078645
542	40	33 1/3	30358955	30358957	30078639	30078665	30078680	30078681	30078645
543	1/6	5/36	30078633	30078636	30702028	30702030	30702033	30702036	30078645
545	1/8	1/6	30350184	30350185	30702028	30702030	30702033	30702036	30078645
547	3 3/5	3	30350184	30350185	30078639	30355561	30702480-1	30702482-1	30078645
549	1 1/4	1 1/24	30701766	30701767	30078639	30700063	30700066	30078670	30078645
30365242–									
501	9	7 1/2	30078633	30078636	30078639	30078642-1	30078645	–	–
503	600	500	30078633	30356370-4	30356370-3	30078642-2	30356378	–	–
504	60	50	30358962	30358965	30078639	30078642-1	30078645	–	–
505	72	60	30358955	30358957	30078639	30078642-1	30078645	–	–
507	150	125	30700536	30700537	30356370-3	30078642	30356378	–	–
508	180	150	30700536	30700537	30356370-3	30078642-2	30651415-1	–	–
509	720	600	30078633	30356370-4	30356370-3	30078642-2	30651415-1	–	–

*60 RPM motor 30362481-503 will provide 2X listed chart speed.
90 RPM motor 30362481-507 will provide 3X listed chart speed.
180 RPM motor 30362481-501 will provide 6X listed chart speed.

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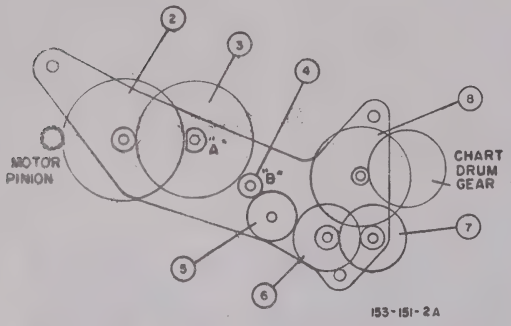

Figure 2. Chart Drive Mechanism 30365241-item

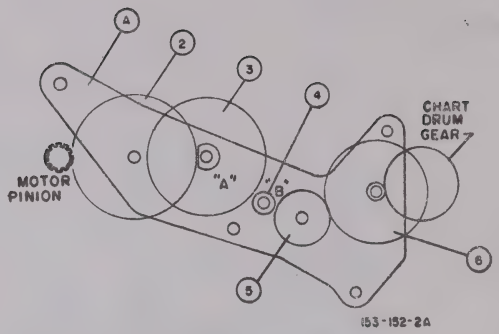

Figure 3. Chart Drive Mechanism 30365242-Item

TABLE 3, CHART SPEED CHANGE GEARS.
SEE FIGURES 2 & 3.

Chart Speed Factor	Change Gears		Repl. Gear Kit 30369701 –item
	Pos. "A"	Pos. "B"	
Installed	30078649 (40T)	30078650 (80T)	. Item 001
2X	30078651 (60T)	30078651 (60T)	
3X	30078594 (72T)	30078654 (48T)	
4X	30078650 (80T)	30078649 (40T)	
1 1/3X	30078654 (48T)	30078594 (72T)	
1 1/5X	30078653 (45T)	30078652 (75T)	item 002 (used on 6, 7 & 8"/hr only)
3 1/3X	30076852 (75T)	30078653 (45T)	
6X	30702295-001 (90T)	30702294-001 (30T)	item 003 (optional)

REMOTE RESERVOIR PEN
SINGLE-PEN, SINGLE FEED

PARTS LIST

Figure and Key No.	Part No.	Description	Quantity
1	367862-It em	pen carriage assembly	1
	367862-1	1530185X recorder	
	367862-2	153168 chromatography recorder (2 sec.)	
1-1	365001	retaining ring	1
1-2	364816	bearing	1
1-3	364813-2	pen carriage sub-assembly	1
1-4	365002	cable clamp	4
1-5	356353	cup washer	2
1-6	79525-6	insulating sleeve	2
1-7	361867-2	screw - 4-20 binding head 1/4"	2
1-8	78877	lockwasher	2
1-9	79526-000	insulating separator	1
1-10		contactor	
	78973-1	1530185X recorder	1
	369746-1	1530785X chromatograph recorder	1
1-11	77968-000	insulating separator	1
1-12	3-161	screw - 4-40 fillister head 3/16"	1
1-13	927	lockwasher	1
1-14	366733-1	clamp	1
1-15	366734-1	bracket	1
1-16	3-161	screw - 4-40 fillister head 3/16"	2
1-17	927	lockwasher	2
1-18	361867-1	screw - 4-40 binding head 3/16"	4
1-19	366731-3	pen support bracket	1
1-20	366729	pivot screw 1-64 x 7/16	1
1-21	77385	locknut for #1 screw	1
2	367850-1	pen assembly	1
2-1	367780-1	vent screw 1-64 bdg. hd. 3/16"	1
2-2	354697-9	"O" ring	1
3	360775	cable clamp	1
4	5-606	screw - 6-32 binding head 3/16"	1
5	366742-1	ink delivery tube	1
6	367778-1	support rod assembly	1
7	367945-1	bracket assembly	1
8	917	lockwasher	2
9	3-83	screw - 8-32 fillister head 1/4"	2
10	369404-1	reservoir and plug assembly	1
10-1	365691-1	plug	1
10-2	366746-1	bottle	1
10-3	724242-1	plug and tube assembly	1
10-4	368343-1	washer	1
10-5	4906	nut	1
10-6	366746-1	"O" ring	1
11	366870-1	Guide rod	

Service Conversion Kits

368458-1 Used to convert instruments which presently have sleeve bearing pen carriage to remote reservoir capillary pen system.

368458-2 Used to convert instruments which presently have ball or roller bearing carriages with a helical slidewire to remote reservoir capillary pen system.

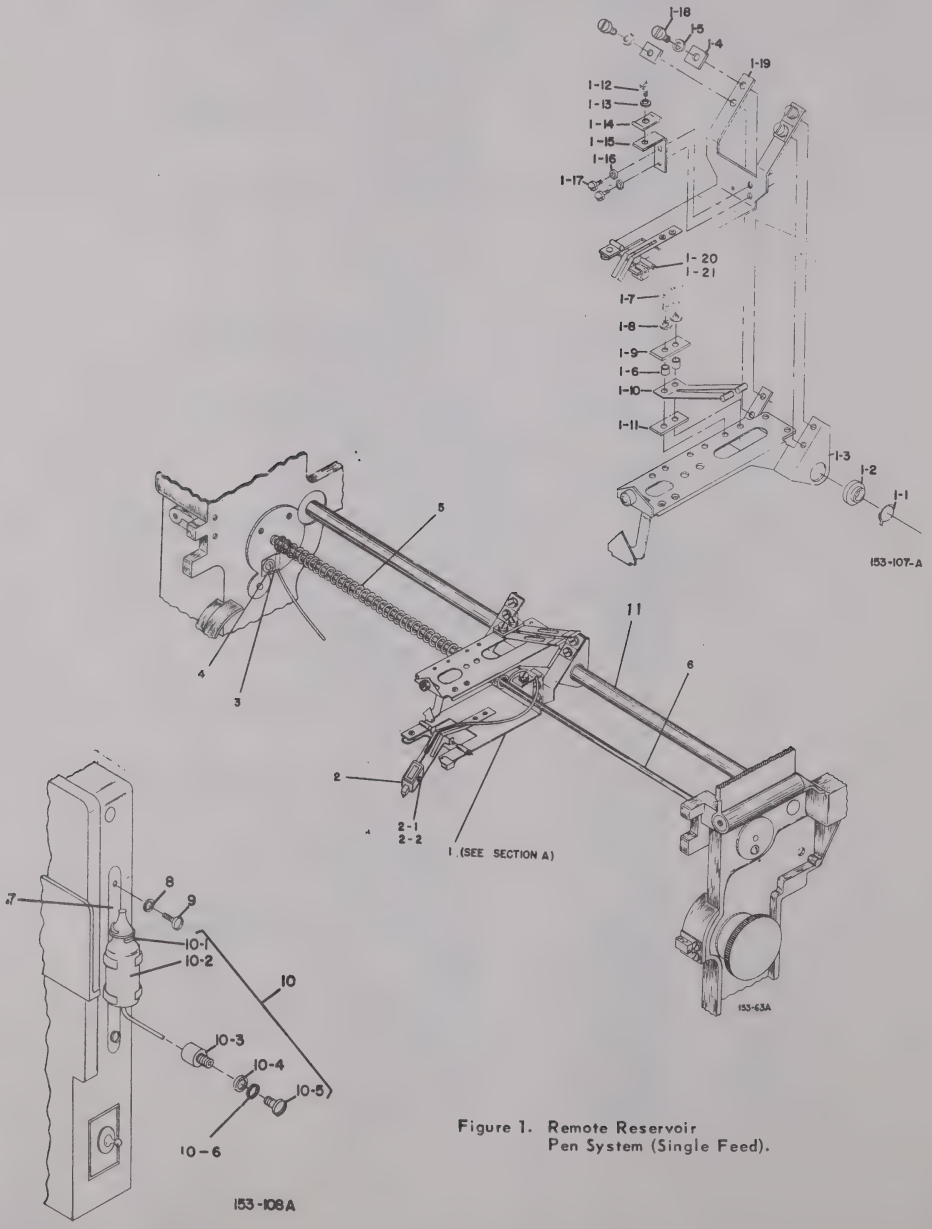

Figure 1. Remote Reservoir Pen System (Single Feed).

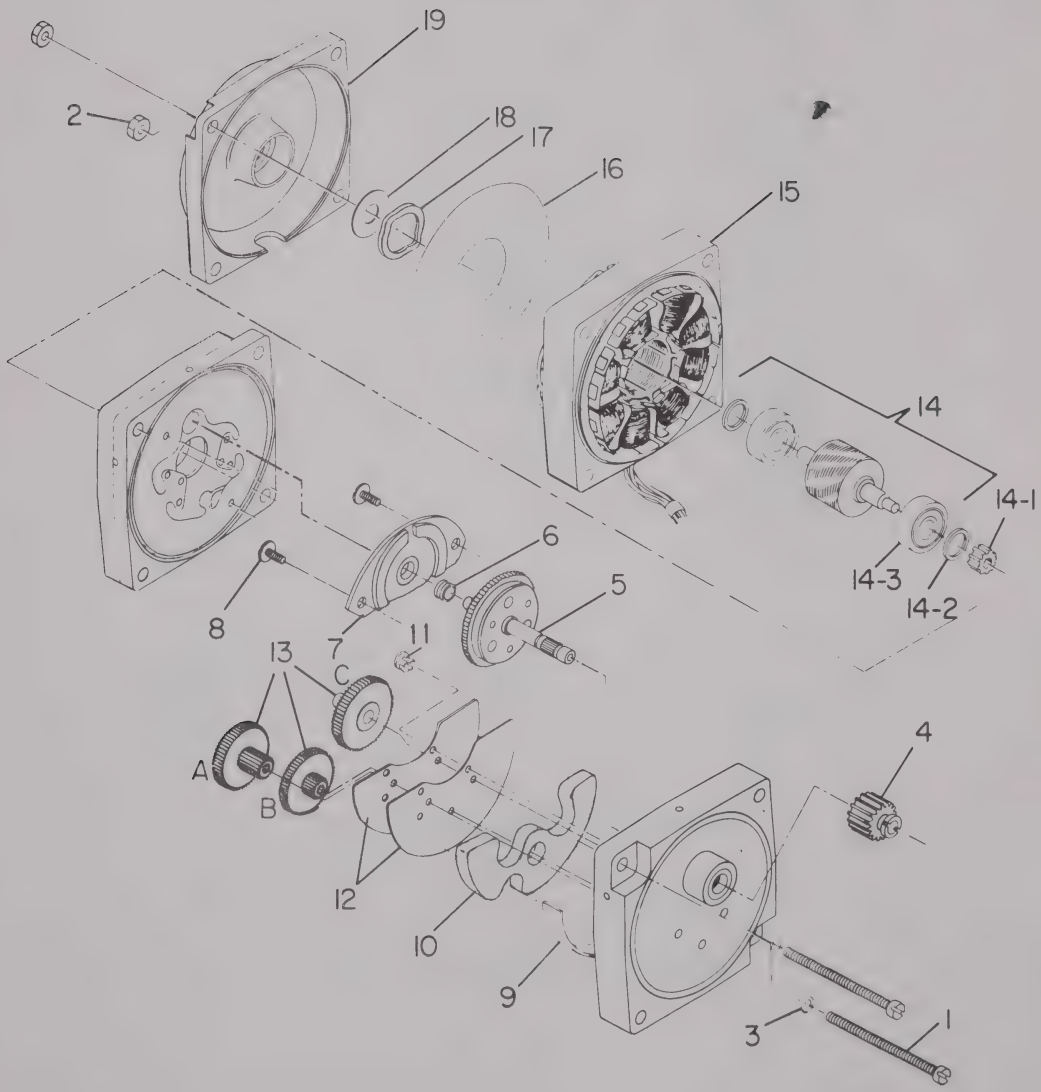

Figure 1. Motor Assembly.

1110-13C

7

Key No.	Part No.	Description	Quantity
1	30000008-032	screw (10-32 fil. hd 2")	2
2	*30005966-000	hex nut (10-32)	2
3	*30000925-000	lockwasher # 10	2
4	30362424-000	output pinion	1
5	30362458-001	output shaft & gear assy.	1
6	30362478-001	spacer	1
7	30362410-001	bearing plate	1
8	*30000005-605	screw (6-32, 5/16")	2
9	30369756-001	oil wick	1
10	30362486-000	oil wick	1
11	see table 2	fastener for wick retainer	1
12	see table 2	wick retainer	2
13	see table 1	change gears A,B,C	as req'd
14	see table 2	armature assy.	1
14-1	see table 1	armature pinion	1
14-2	30689250-001	washer	2
14-3	30685630-001	ball bearing	2
15	see table 2	stator & cable assy.	1
16	30362628-000	insulator	1
17	30689080-001	spring washer	1
18	30362455-001	shim washer	as req'd
19	30362415-000	rear housing	1

* commercially available parts

Table 1. Change Gears

Gear Ratio	Key No. 13			Key No. 14-1
	Gear "A" & No. of Teeth	Gear "B" & No. of Teeth	Gear "C" & No. of Teeth	Armature Pinion
10:1	Omit	Omit	30362434-000 (35T & 14T)	30362442-000 (15T)
20:1	30362446-000 (42T & 27T)	30362444-000 (33T & 14T)	30362450-001 (46T)	30362441-000 (11T)
30:1	30362439-000 (42T & 12T)	30362400-000 (44T & 28T)	30362450-002 (28T)	30262441-000 (11T)
60:1	30362439-000 (42T & 12T)	30362402-000 (44T & 14T)	30362450-001 (46T)	30362441-000 (11T)

Table 2

Motor 30362481-50X	115 Volts 50/60 Hertz						115V 25 Hz	
	501 †509	502 †510	503 †511	507 †512	506	**508	504	505
Gear Ratio	10:1	30:1	60:1	20:1	10:1	60:1	25:1	12 1/2:1
RPM	180	60	30	90	180	30	30	60
Torque oz/in	12	18	36	12	2	36	30	15
Key Part No.								
11 30362489-000	1				1		1	1
12 30362487-001	2	2	2		2	2		
30362487-002				2				
30362487-003							2	
14 30365249-501	1				1			
30365249-502		1	1	1		1		
30365249-503							1	1
15 30365457-507	1							
30365457-508		1	1	1				
30365457-509							1	1
30365457-510					1			
30365457-526						1		

** this motor has 12" cable
† stator & rear housing are rotated 180°

7

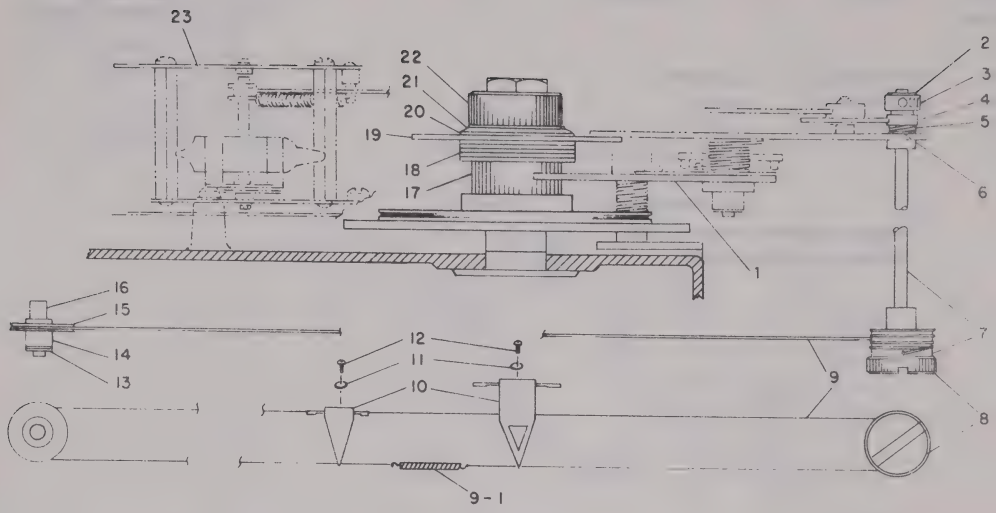

Figure 1 - Front Set Control Index

Figure and Key No.	Part No.	Description	Control single	Index dual
1	†	control index mechanism	1	1
	*	mtg. screw 10-32, 3/8"	3	3
	*	mtg. lockwasher # 10	3	3
2	30040032-000	cotter for mtg. cable drum & shaft	1	2
3	30040958-002	set screw	2	4
4	30352566-000	index pinion	1	2
5	30353143-000	spring	1	2
6	30040652-000	washer	1	2
7	30352574-001	cable drum & shaft	1	1
	30352574-002	cable drum & shaft	–	1
8	30352581-000	cap for cable drum	1	2
	*	cap mtg. screw 10-32, 5/16"	1	2
9	30352585-000	index drive cable & spring	1	2
9-1	30352586-000	spring only	1	2
10	30352584-000	lower index pointer, green	1	1
	30355159-000	upper index pointer, red	–	1
11	30006581-000	lockwasher	1	2
12	30000030-001	mtg. screw	1	2
13	30009748-000	cotter	1	2
14	30077249-000	spacer shims (as req'd)	1	2
15	30352580-000	pulley	1	2
16	30352573-000	mtg. stud	1	2
17	30352619-000	ring gear	1	2
18	30077214-000	spacers (as req'd)	1	2
19	30352568-000	cam (actuates aux. backset switch - optional)	1	1

*commercially available parts
† see separate section for detail parts list

Figure and Key No.	Part No.	Description	Control Index Single	Control Index Dual
20	30077216-000	key washer	1	1
21	30078022-000	washer	2	2
22	30078021-000	thumb nut	1	1
23	†	mercury switch contact control assy.	1	1
	*	mtg. screw 10-32, 3/8"	3	3
	*	mtg. lockwasher # 10	3	3

† see separate section for detail parts
* commercially available parts

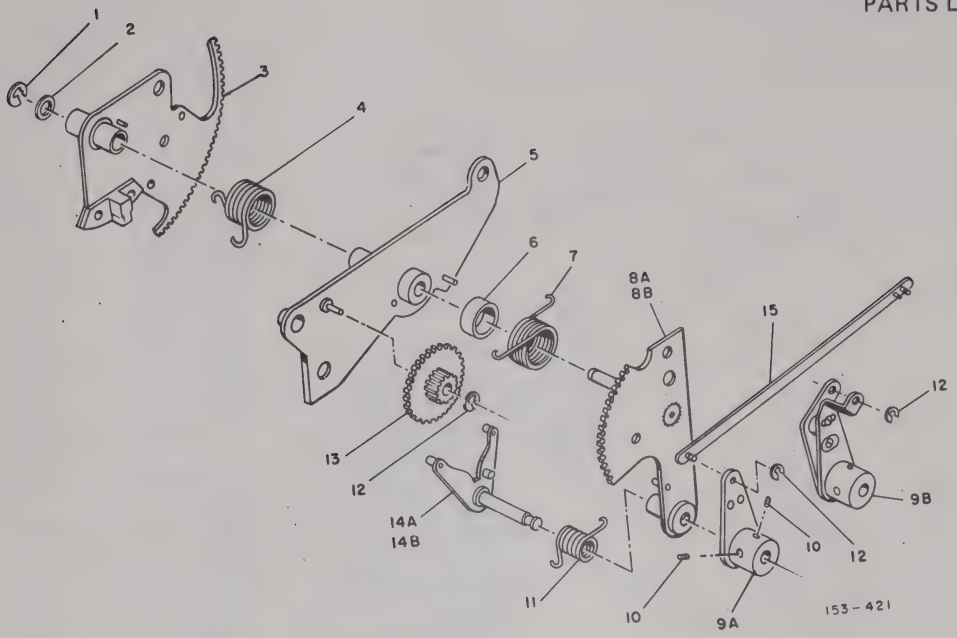

Figure 1 - Single Index Contact Control Mechanism

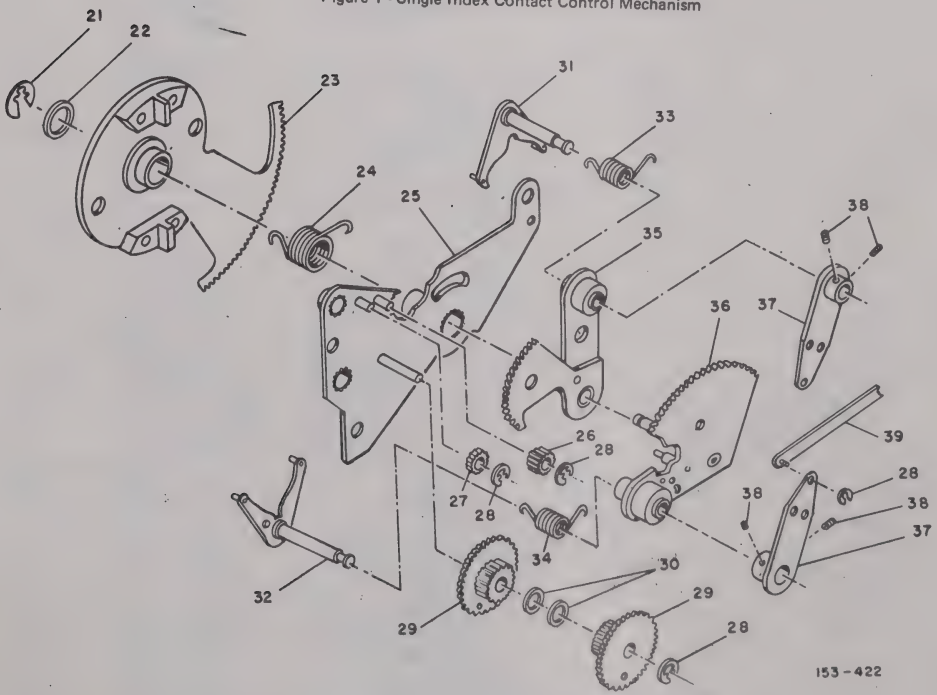

Figure 2 - Dual Index Contact Control Mechanism

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ELECTRONIK 153
MERCURY SWITCH CONTACT CONTROL ASSEMBLY
SINGLE & DUAL INDEX
PARTS LIST

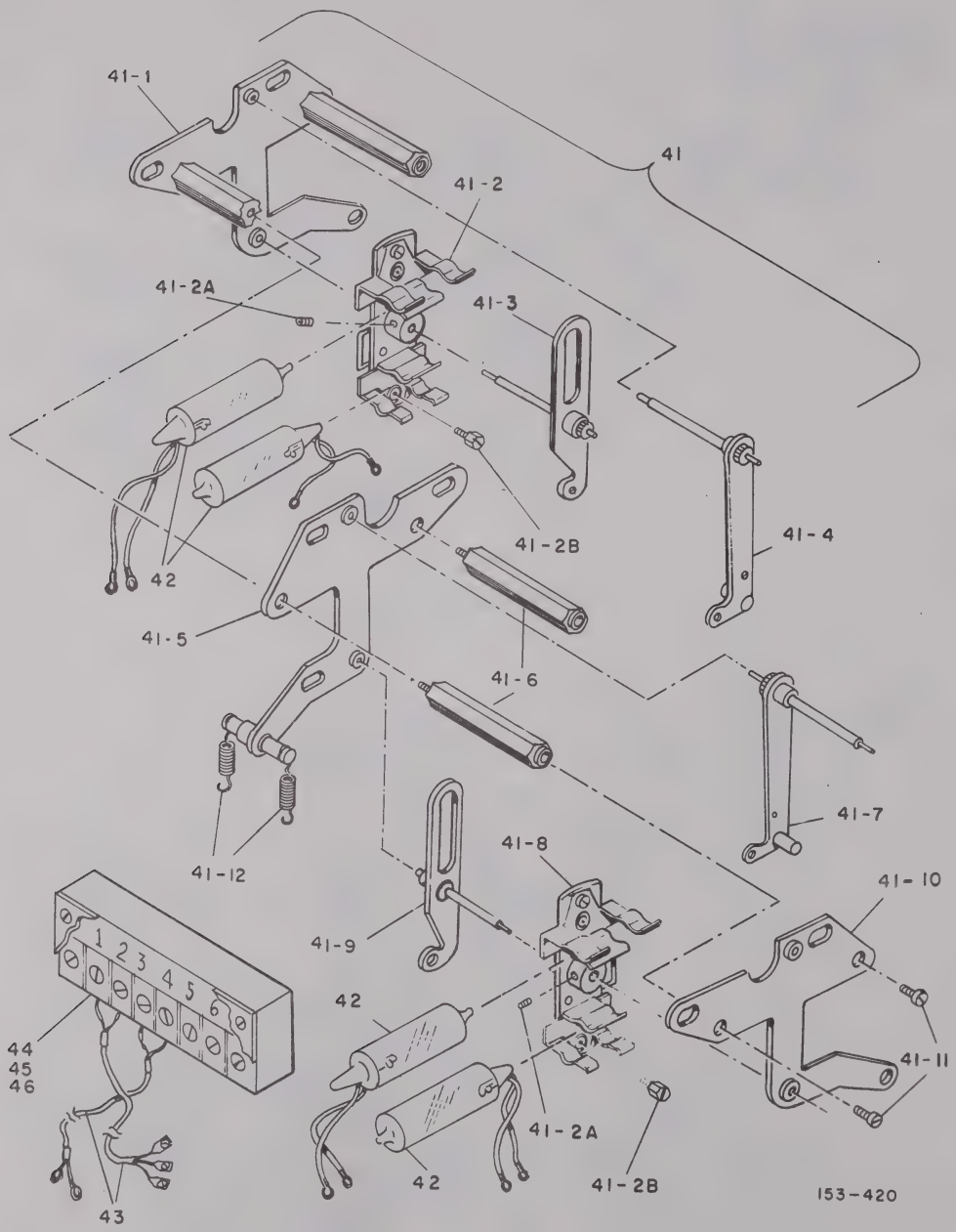

Figure 3 - Single & Dual Mercury Control Switch Assembly

Figure and Key No.	Part No.	Description	Quantity
1			
–	30352646-001	single index mechanism, (used with single control switch)	1
–	30352646-002	single index mechanism, (used with dual control switch)	1
1	30009748-000	cotter	1
2	30004971-000	washer	1
3	30353036-000	pen positioned sector gear	1
4	30352608-000	spring	1
5	30352613-000	mtg. plate for mechanism	1
6	30352618-000	sleeve for index sector gear	1
7	30352564-000	spring for index sector gear	1
8A	30353037-001	index sector gear assy. (used with single control switch)	1
8B	30353041-001	index sector gear assy. (used with dual control switch)	1
9A	30352616-000	link lever assy. (used with single control switch)	1
9B	30353042-000	link lever assy. (used with dual control switch)	1
10	30040958-001	set screw for link lever	2
11	30352602-000	spring for slotted lever assy.	1
12	30007403-000	cotter	2
13	30352561-000	gear & pinion assy.	1
14A	30352567-001	slotted lever assy. (used with single control switch)	1
14B	30352567-002	slotted lever assy. (used with dual control switch)	1
15	30352630-001	connecting link, single control sw.	1
	30353040-001	connecting link, dual control sw.	2
Figure 2			
–	30355120-000	dual index mechanism	1
21	30009748-000	cotter	1
22	30004967-000	washer	1
23	30355125-000	pen positioned sector gear assy.	1
24	30355128-000	spring for pen sector gear	1
25	30355121-000	mtg. plate for mechanism	1
26	30355136-001	idler pinion	1
27	30355136-002	idler pinion	1
28	30007403-000	cotter	3
29	30352561-000	gear & pinion assy.	2
30	30004973-000	washer	2
31	30355139-001	slotted lever assy. (upper)	1
32	30355139-002	slotted lever assy. (lower)	1
33	30355129-001	spring for upper lever	1
34	30355129-002	spring for lower lever	1
35	30355130-000	upper index sector assy.	1
36	30355135-000	lower index sector assy.	1
37	30352616-000	link lever assy.	2
38	30040958-001	set screw	4
39	30352630-001	connecting link assy.	2
40	30005854-000	mtg. washer	2

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ELECTRONIK 153
MERCURY SWITCH CONTACT CONTROL ASSEMBLY
SINGLE & DUAL INDEX
PARTS LIST

Figure and Key No.	Part No.	Description	Dual Switch, Multiple Control		
			Single Switch Unit	Dual Switch Unit	
3					
–	see table 1	mercury switch contact control assy.	1	1	1
	*	mtg. screw 8-006 & lockwasher 74022	2 ea	2 ea	2 ea
41	30352541-001	control switch assy. (less bottles)	1		
	30352542-000	control switch assy. (less bottles)		1	
	30355149-000	control switch assy. (less bottles)			1
41-1	30352633-000	mtg. plate	1	1	1
41-2	30352555-001	switch mtg. strip assy.	1	1	1
41-2A	30365486-001	set screw	2	4	4
41-2B	30352643-000	hex head screw	2	4	4
41-3	30352640-001	slotted lever & shaft	1	1	1
41-4	30352665-000	lever assy.	1	1	1
41-5	30352634-001	mtg. plate	1		
	30352635-000	mtg. plate		1	
	30355150-000	mtg. plate			1
41-6	30352636-000	spacer		2	2
41-7	30353039-000	lever assy.		1	1
41-8	30352556-000	switch mtg. strip assy.		1	
	30352555-001	switch mtg. strip assy.			1
41-9	30352641-000	slotted lever & shaft		1	
	30355154-000	slotted lever & shaft			1
41-10	30351645-000	mtg. plate		1	
	30355152-000	mtg. plate			1
41-11	*	mtg. screw	2	2	2
41-12	30352644-000	spring	1	2	2
42	see table 1	mercury bottles	as required		
43	see table 1	cables, chassis to rear of case	as required		
44	see table 1	chassis terminal block	1	1	1
45	see table 1	case terminal block	1	1	1
46	see table 2	terminal block components	as required		
	*	mtg. screw 8-012 & lockwasher 925	as required		
47	30682187-002	kit of terminal connectors	1	1	1

*commercially available parts

Table 1 - Ordering Data & Variable Component Parts and Their Usage

Control Option Table IV	Control Inputs	Hg. Switch Control Assembly	Switch Action	Key No. 42 Hg. Bottles	No. Indices, No. Switches	Key No. 43 Cables	Key No. 44 Chassis Term. Block	Key No. 45 Case Term. Block
32	1	365161-1	SP3T	(4) 350964-2	1 & 2	(2) 350927-2	353002	78397
37	1	366336-1	SPST	(2) 350964-2	1 & 2	(1) 350957-1 (1) 350846-5	76232	76232
33	1	366951-1	(1) SPDT (2) SPST	(4) 353003-1	1 & 2	(2) 350927-2	353002	78397
24	1	365160-3	SPDT	(2) 350946-2	1 & 1	(1) 350927-2	76232	76232
25, 31	1	365160-4	SPDT	(2) 353003-1	1 & 1	(1) 350927-2	76232	78397
28, 36	1	365160-6	SPDT	(2) 353003-1	1 & 1	(1) 350927-2	76232	76232
122, 128	2	365163	(2) SPDT	(2) 354321	2 & 2	(1) 354344 (1) 354345	76232	†
29	1	365162-1	SPDT	(1) 354321	1 & 1	(1) 354344 (1) 79615-4	78406	†
121	2	365162-1	SPDT	(1) 354321	1 & 1	(1) 354344 (1) 79615-4	78406	†
128	2 or 3	365162-1	SPDT	(1) 354321	1 & 1	(1) 354344 (1) 79615-4	78406	†
52	1	365162-3	SP3T	(2) 354321	1 & 1	(1) 354344 (1) 354345	76232	†

†See multiple controller, rear of case section

Table 2, Key No. 46, Terminal Block Components

Terminal Block	Inputs	Cover	Marker Strip	Terminal Screws	Mounting Screws	Spacers
76232	6 Pt.	76282	76289	(4) 76653	–	–
78406	3 Pt.	78402	78403-1	(4) 76653	–	–
78397	8 Pt.	78404	78405-1	(8) 6-805	–	–
353002	8 Pt.	76262	353004	(7(6-032	353000	353001

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Process Control Division/Fort Washington, 1100 Virginia Drive, Fort Washington, Pa. 19034

Honeywell

Honeywell Charts

Honeywell charts are specially designed and made exclusively for use with the Honeywell recorder and are calibrated and tested to insure the very best of records. As the owner of Honeywell recorders, you will naturally want to help maintain its high accuracy and sensitivity by using Honeywell charts.

There are two types of charts, circular and strip, and each type and size is available with a wide variety of ranges and calibrations to suit your every need.

Here are the features that make Honeywell charts the highest quality charts available. Along every step of the production line—from the blending of wood pulps to the packaging and shipping of your charts—strict requirements and controls are enforced to guarantee the quality and precision workmanship so necessary to best serve your needs.

Features

COMPOSITION
All Honeywell charts are made from 100% bleached chemical wood pulp, free from groundwood, de-inked stock, or low-grade pulps. This guarantees uniformity throughout.

STRENGTH
Special treatments of all chart papers give the best writing surface; charts are treated for wet strength so that an oscillating pen will not feather or break through.

DIMENSIONAL STABILITY
The expansion or contraction of chart papers will not exceed an average of 1% from 10 to 85% relative humidity change. And we're continually working to reduce this low figure.

CALIBRATION
An electronic computer which calculates the number of graduations, the degrees of thickness of each line marking, and the exact distances between lines, provides the most accurate, uniform charts available.

HUMIDITY COMPENSATION
Standard strip charts have elongated holes on one side. This permits any fractional expansion or contraction of chart, due to changes in humidity, to take place in least-used portion of chart.

SMOOTHNESS
The high-quality pulp, uniform thickness, and expertly controlled calendering of Honeywell chart paper insure a smooth surface that will offer a negligible amount of resistance to the recording pen.

BRIGHTNESS
All Honeywell charts are easy to read because they have a brightness rating of 77 to 87 as measured on a G.E. brightness meter. Your operators can easily see chart graduations, time markings, recording marks, etc.

APPEARANCE
All Honeywell charts are clean, well-formed, and free of dirt particles, slime spots, holes, and similar defects.

SPECIAL PAPER
Charts can be made to order in special colors and special papers (such as Vellum for excellent reproducibility).

PACKAGING
All strip charts are rolled on a cardboard spool that easily fits into position in the recorder. Strip Charts are packaged individually; circular charts 100 to a box. All boxes have adequate space to record dates, etc., and serve as convenient, space saving containers for storing charts after use.

Specifications

STRIP CHARTS

Honeywell Recorder	*VumatiK* and *VutroniK*	*ElectroniK 1113*	*ElectroniK*		*ElectroniK 153 and 1123*
			195	*196*	
Chart Roll Size	4.328"	6.5"	6.5"	11.3"	12"
Calibrated Width	4"	6"	6"	10.433"	11"
Length	53 ft.	122 ft.	122 ft.		122 ft.
Line Color	Beige	Gray	Green		Blue
Number Color	Black	Black	Green		Black
Std. Time Markings	3/4", 1", 1 1/2"	1/2", 1", 2", 4"	10 lines/"		1/2", 1", 2", 4"
Packaged Unit/box	1 roll	1 roll	1 roll		1 roll

CIRCULAR CHARTS

Honeywell Recorder	*ElectroniK 1112*	RH and Temperature Class 612	Class 60, 70	Class 152, 22, 45, 47, 60 & 70
Chart Diameter	6.5"	8"	10"	12"
Calibrated Width	3"	3.268"	4.75"	4.75"
Line Color	Beige	Blue	Blue	Blue
Number Color	Beige	Blue	Blue	Blue
Packaged Unit/Box	100	100	100	100

USE HONEYWELL CHARTS AND INK

Remember . . . . . the quality of the record is only as good as the chart paper and ink that is used. Your new Honeywell recorder includes Honeywell chart and ink and we urge you to continue to use only these same products when replacement is necessary.

None better . . . . . there is no better quality available anywhere than we furnish in Honeywell charts and you can continue to obtain this high quality recording performance by specifying the number that appears on the chart and ordering it from your local Honeywell sales office.

They're ready . . . . . we inventory hundreds of thousands of charts which are available for immediate shipment to you. In fact, we can ship within 24 hours when you need it.

USE HONEYWELL SENSORS

The performance of any measurement and control system depends on the quality and accuracy of your primary sensor. Honeywell provides a full line of Sensing Devices including Thermocouples, Protecting Tubes and Compensated Wire. Most items are stocked and available for quick delivery. We strongly recommend your continued use of Honeywell sensing components to insure the ultimate in performance from your Honeywell equipment.

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Printed in U.S.A.